



CITY OF ORLAND

GLENN COUNTY, CALIFORNIA

CONTRACT DOCUMENTS

FOR

ORLAND EMERGENCY GROUNDWATER RESOURCE PROJECT - PHASE 4

April 2024

PREPARED BY:



SET NO. 01





**CITY OF ORLAND
GLENN COUNTY, CALIFORNIA**

CONTRACT DOCUMENTS

FOR

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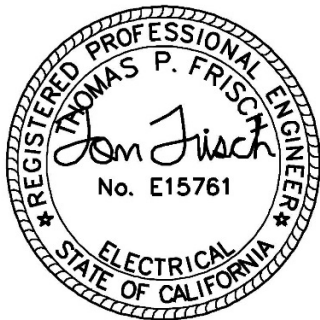
April 2024

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Contract Documents were prepared by or under the direction of:

Cody Trueblood, PE, PMP



**GEI Consultants, Inc.
11010 White Rock Road, Suite 200
Rancho Cordova, CA 95670**



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NOTICE TO BIDDERS

1.00 NOTICE INVITING BIDS

Sealed bids will be received at City Hall, City of Orland, 815 Fourth Street, Orland, California, 95963 until 2:00 p.m., **May 16, 2024**. At that time, all bids will be publicly opened, examined and declared for construction of:

ORLAND EMERGENCY GROUNDWATER RESOURCE PROJECT - PHASE 4

2.00 GENERAL WORK DESCRIPTION

The work to be done under this Contract consists of the installation of a 1-million gallon welded steel water storage tank, installation of 2 new booster pumps and associated electrical and instrumentation, construction of prefabricated metal structure, connecting to the existing City water system and installing site water main piping, storm drain piping and appurtenances and connecting to the new water main. new storm drain system, and associated site work.

The work is comprised of 63 Bid Items. Bids are required for the entire work described herein. Based upon available funding, a contract, if awarded, will be in accordance with Section 9.

Work shall be completed within 365 WORKING DAYS from the issuance of the Notice To Proceed by the Owner.

The Contractor shall possess either a Class A license or a combination of Class C licenses which constitutes a majority of the work at the time this contract is awarded. The Contractor must be properly licensed as a contractor from contract award through contract acceptance.

A contractor or subcontractor shall not be qualified to bid on, be listed in a bid proposal, subject to the requirements of Section 4104 of the Public Contract Code, or engage in the performance of any contract for public work, as defined in Division 2, Part 7, Chapter 1 of the Labor Code, unless currently registered and qualified to perform public work pursuant to Section 1725.5 of the Labor Code. It is not a violation of Section 1771.1 for an unregistered contractor to submit a bid that is authorized by Section 7029.1 of the Business and Professions Code or by Section 10164 or 20103.5 of the Public Contract Code, provided the contractor is registered to perform public work pursuant to Section 1725.5 at the time the contract is awarded.

The Contractor is to carefully examine the site of the proposed work, and is to make his or her own determination of the scope of the work to be performed, including but not limited to the soil conditions and/or groundwater conditions to be encountered in performing the work, and he or she is to carefully examine these Contract Documents.

Inquiries or questions based on alleged patent ambiguity of the plans, specifications or estimate must be communicated as a bidder inquiry prior to bid opening. Any such inquiries or questions, submitted after bid opening, will not be treated as a bid protest. Bidders' inquiries may be presented to the City Engineer by phone at (530) 895-1422 or by U.S. Mail at Orland Emergency Groundwater Resource Project - Phase 4, c/o Rolls Anderson & Rolls, 115 Yellowstone Drive, Chico, CA 95973.

3.00 BID SUBMITTAL REQUIREMENTS

Bids are required for the entire work described herein and no bid will be accepted unless it is made on forms furnished by the City of Orland. **To ensure consideration, the Bid must be enclosed in a sealed envelope, clearly marked BID which also bears the name of the project and the date and time set for opening of Bids.** Each Bid must be accompanied by cash, certified or cashier's check, or bidder's bond made payable to the City of Orland for an amount equal to ten percent (10%) of the amount bid, such guaranty to be forfeited should the bidder to whom the Contract is awarded fail to execute the Contract.

NOTICE TO BIDDERS

No Bid will be accepted from a Contractor who is not currently licensed in accordance with the provisions of Chapter 9, Division III of the Business and Professions Code. Subcontractors shall also be licensed as required by said code.

Each bid shall also include the Contractor's Qualifications list as described in Section 10.00 Contractor's Qualifications.

4.00 PREVAILING WAGES

Pursuant to Section 1773 of the Labor Code of the State of California, the general prevailing wage rates in the county, or counties, in which the work is to be done have been determined by the Director of the California Department of Industrial Relations. These wages are set forth in the General Prevailing Wage Rates for this project, available at the City of Orland address and available from the California Department of Industrial Relations' Internet web site at <http://www.dir.ca.gov/DLSR/PWD>. Future effective general prevailing wage rates, which have been predetermined and are on file with the California Department of Industrial Relations are referenced but not printed in the general prevailing wage rates.

5.00 APPRENTICESHIP STANDARDS

In accordance with the provisions of Part 7, Chapter 1, Article 2, Section 1777.5 of the Labor Code of the State of California, the prime contractor shall be responsible for fully complying with the provisions of this Section, as well as any regulations adopted by the Director of Industrial Relations, for all apprenticeable crafts or trades, and shall also assure compliance by his or her sub-contractors with respect to such apprenticeable crafts or trades.

6.00 INSURANCE AND BONDS REQUIRED

The successful bidder to whom the Contract is awarded will be required to furnish appropriate insurance certificates as required by Section 4.00 of the General Conditions and the Special Conditions. He or she shall also furnish a Payment Bond in an amount equal to the total Contract amount and a Faithful Performance Bond in the amount equal to the total Contract amount, with a corporate surety approved by the City of Orland.

7.00 PAYMENT OF RETENTION AND SUBSTITUTION OF SECURITIES

Five percent (5%) will be withheld from each progress payment made to the Contractor for work performed and will be held until completion of the work, its acceptance and the expiration of the period provided by law for filing of liens by laborers or materialmen. In accordance with the provisions of Public Contract Code Section 22300, securities may be substituted for any monies which the City may withhold pursuant to the terms of the Contract to insure performance.

8.00 BIDDER'S INFORMATION

Contract Documents, including Plans and Specifications, are available for inspection on the City of Orland's website: www.cityoforland.com ; at the Valley Contractors Exchange at 951 E. 8th Street, Chico, California; and Shasta Builders Exchange at 2990 Innsbruck Drive, Redding, California. Copies are available for purchase at the Public Works Department located in the City Hall, City of Orland, 815 Fourth Street, Orland, California; and Rolls, Anderson & Rolls, 115 Yellowstone Drive, Chico, California, (530) 895-1422, for a **NON-REFUNDABLE PAYMENT** of \$1.00 per plan sheet and \$0.10 per bid book/technical specifications sheet, plus \$10.00 mailing charge if mailing is requested.

9.00 BID AWARD

The Contract, if awarded, will be awarded within 30 days after the opening of Bids, to the lowest responsible bidder as determined by the City of Orland. The City reserves the right, in its sole discretion, to reject any and all bids for any reason whatsoever, or to waive minor irregularities in any bid, and to accept any bid.

The City at their discretion shall reward either Bid Schedule 1, Bid Schedule 2, Bid Schedule 3, or Bid Schedule 4.

NOTICE TO BIDDERS

10.00 CONTRACTORS QUALIFICATIONS

The Contractor shall provide, as part of the Bid, a list with at least three (3) projects, of similar nature, that have been completed over the last five years. The Contractor shall provide:

1. Type of project;
2. Name of local agency;
3. Contact person of local agency;
4. Phone number of local agency;
5. Total project cost; and
6. Time taken to complete project.

/s/ Ed Vonasek
Ed Vonasek
Public Works Director
City of Orland

Date: April 9, 2024

Publish Date: April 9, 2024

NOTICE TO BIDDERS



INSTRUCTIONS TO BIDDERS

1.00 INTRODUCTION

Each Bid shall be in accordance with the Contract Documents prepared by GEI Consultants Inc., 11010 White Rock Road, Suite 200, Rancho Cordova, CA 95670. Contract Documents are available as specified in the Notice to Bidders.

2.00 DEFINITION OF TERMS

2.01 CONTRACT DOCUMENTS

The Contract Documents consist of the Notice to Bidders, Instructions to Bidders, Bidder's Signature, Contract, General Conditions, Supplemental General Conditions, Special Conditions, Technical Specifications, Appendices, Plans, and any Addenda.

2.02 CONTRACT

The Contract is the written agreement covering the performance of the work and the furnishing of labor, materials, tools, and equipment in the construction of the work. It includes supplemental agreements amending or extending the work contemplated and which may be required to complete the work agreements covering alterations, amendments or extensions to the Contract and includes Contract Change Orders.

2.03 OWNER, CONTRACTOR, AND ENGINEER

The Owner, the Contractor, and the Engineer are those mentioned as such in the Special Conditions. They are treated throughout the Contract Documents as if each were of the singular number and the masculine gender.

2.04 BIDDER

Any individual, firm, partnership, or corporation submitting a Bid for the work contemplated, acting directly or through a duly authorized representative.

2.05 BID

The offer of a Bidder for the work when made out and submitted on the prescribed Bid form, properly signed and guaranteed.

2.06 BID GUARANTEE

The cash, cashier's check, certified check or Bidder's Bond accompanying the Bid submitted by the Bidder, as a guarantee that the Bidder will enter into a Contract with the Owner for the performance of the work if the Contract is awarded to him.

2.07 EFFECTIVE DATE OF THE CONTRACT

The date on which the governing body or an authorized representative of the Owner awards the Contract.

2.08 DATE OF EXECUTION OF THE CONTRACT

The date on which the Contract is signed by the Owner's authorized representative.

2.09 DAYS

Unless otherwise specifically stated, the term "days" will be understood to mean calendar days.

2.10 WORK

The terms "work" or "Work" means all the work specified, indicated, shown or contemplated in the Contract Documents, including all alterations, amendments or extensions thereto made by Contract Change Order or other written orders of the Owner.

2.11 SPECIFICATIONS

INSTRUCTIONS TO BIDDERS

The term "specifications" refers to the terms, provisions and requirements contained herein and referred to as General Conditions, Special Conditions and Technical Specifications. Where Standard Specifications such as those of ASTM, AASHTO, etc., have been referred to, the applicable portions of such Standard Specifications shall become a part of these Contract Documents.

2.12 PLANS

The term "Plans" refers to the official Plans, profiles, cross sections, elevations, details and other working drawings and supplementary drawings, or reproductions thereof, signed by the Engineer, which show the location, character, dimensions, and details of the work to be performed. Plans may either be bound in the same book as the balance of the Contract Documents or bound in separate sets and are a part of the Contract Documents regardless of the method of binding.

3.00 PREPARATION AND SUBMISSION OF BIDS

Bids must be submitted on the forms bound in the Contract Documents and must be "wet signed" by the Bidder or his authorized representative. Any corrections to the entries made on the Bid forms must be initialed by the person signing the Bid.

Bidders must bid on all items appearing on the Bid Item List unless specific directions allow for partial bids. Failure to bid all items may disqualify the Bid. If bids on all items are not required, Bidders shall insert the words "No Bid" where appropriate. Alternate bids will not be considered unless specifically called for in the Bid.

Telegraphic Bids or facsimile Bids will not be considered. Modifications to Bids already submitted will be allowed if received in writing, by facsimile or by telegram prior to the time fixed in the Notice to Bidders for opening of Bids. Modifications shall be submitted as such and shall not reveal the total amount of either the original or revised Bid.

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

To ensure consideration, the Bid should be enclosed in a sealed envelope, clearly marked **BID** which also bears the name of the project and the date and time set for opening Bids. The sealed envelope containing the Bid should be filed at the place and before the time set for opening of Bids. Bids received after the time indicated will be returned unopened.

4.00 WITHDRAWAL OF BIDS

Any bidder may withdraw his Bid, either personally or by facsimile, telegraphic or written request at any time prior to the scheduled closing time for receipt of bids. No bidder may withdraw his bid for a period of 30 days after the date set for opening. Negligence on the part of the bidder in preparing his bid shall not constitute a right to withdraw his bid subsequent to the bid opening.

5.00 BID GUARANTEE

Bids shall be accompanied by cash, certified check, cashier's check or "wet signed" Bidder's Bond made payable to the Owner. The bidder's bond shall conform to the bond form in these Contract Documents and shall be properly filled out and executed. The bidder's bond form included in these documents may be used. Facsimile copies of checks or executed Bidder's Bonds will not be accepted. The Bid Guarantee must be enclosed in the same envelope with the Bid. The amount of the Bid Guarantee shall not be less than 10 percent of the total amount of the Bid.

6.00 ADDENDA AND EXPLANATIONS TO BIDDERS

Any request for explanation or interpretation of the Contract Documents must be made in writing at least seven (7) days before the time set for opening of Bids. Any explanation or interpretation will be made in the form of Addenda to the Contract Documents and shall be furnished to all Bidders. Bidders shall

INSTRUCTIONS TO BIDDERS

submit signed copies of all Addenda with their Bids. Oral explanations and interpretations will not be binding.

7.00 DISCREPANCIES

In case of discrepancies between unit prices and totals, unit prices will prevail. In case of discrepancy between words and figures, words will prevail.

8.00 ACCEPTANCE OR REJECTION OF BIDS

The Owner reserves the right to reject any or all Bids and to waive any informality in any Bid.

The award of Contract, if made, will be to the lowest responsible Bidder whose Bid complies with the requirements of the Contract Documents. The award, if made, will be made within 30 days after the opening of Bids. If the lowest responsible Bidder fails to sign and return the Contract with acceptable bonds and certificates of insurance, the Owner may award the Contract to the next lowest responsible Bidder.

9.00 CONTRACT BONDS

The successful Bidder shall furnish a Performance Bond in the amount of 100 percent of the total Contract amount and a Payment Bond in the amount of 100 percent of the total Contract amount.

10.00 EXECUTION OF CONTRACT

The effective date of the Contract shall be the date on which the governing body or an authorized representative of the Owner awards the Contract.

The Bidder whose Bid is accepted, and to whom the Contract is awarded, shall sign and return the Contract with acceptable bonds and certificates of insurance within 14 calendar days after receiving notice that the Contract has been awarded to him. Failure to do so shall be just cause for annulment of the award and for forfeiture of the Bid Guarantee.

Within seven (7) days after receiving the signed Contract with acceptable bonds, and evidence of satisfactory insurance, from the successful Bidder, the Owner's authorized agent will sign the Contract. Signature by both parties constitutes execution of the Contract.

11.00 RETURN OF BID GUARANTEES

Within 15 days after the award of the Contract, the Owner will return the Bid Guarantees, other than Bidder's Bonds, to all Bidders whose Bids are not to be further considered in awarding the Contract. Retained Bid Guarantees will be held until the Contract has been finally executed, after which all Bid Guarantees, other than Bidder's Bonds and any guarantees which have been forfeited, will be returned to the respective Bidders whose Bids they accompanied.

INSTRUCTIONS TO BIDDERS



BID ITEM LIST

Base Bid: Orland Emergency Groundwater Resource Project - Phase 4

Item No.	Description	Approx. Quantity	Unit Price	Total Price
1.	Mobilization/Demobilization	Lump Sum	Not Applicable	\$
2.	Environmental Compliance	Lump Sum	Not Applicable	\$
3.	Site Management	Lump Sum	Not Applicable	\$
4.	Project Identification Sign	1 EA	\$	\$
5.	Demolition, Clearing, And Grubbing	Lump Sum	Not Applicable	\$
6.	Potholing And Utility Coordination - Site	Lump Sum	Not Applicable	\$
7.	Water System Tie-In Connection	Lump Sum	Not Applicable	\$
8.	12 -Inch Restrained Class 350 Ductile Iron Pipe - Watermain	105 LF	\$	\$
9.	18 -Inch Class 350 Ductile Iron Pipe - Watermain	35 LF	\$	\$
10.	12-Inch Buried Flexible Expansion Joint	1 EA	\$	\$
11.	18-Inch Buried Flexible Expansion Joint	1 EA	\$	\$
12.	Hydrostatic Pressure Testing and Disinfection of Site Piping and Pump Station	Lump Sum	Not Applicable	\$
13.	18-Inch X 18-Inch Concrete Vaults	2 EA	\$	\$
14.	36-Inch X 36-Inch Concrete Vault	1 EA	\$	\$
15.	36-Inch X 60-Inch Concrete Vault	1 EA	\$	\$
16.	21-Inch SDR 35 PVC (Storm Drain)	35 LF	\$	\$
17.	12-Inch SDR 35 PVC (Storm Drain)	26 LF	\$	\$
18.	12-Inch Class 50 Ductile Iron Pipe (Storm Drain)	84 LF	\$	\$
19.	Site Grading	Lump Sum	Not Applicable	\$
20.	Swale	180 LF	\$	\$
21.	6-Foot-Tall Chain Link Fence and Swing Gate	538 LF	\$	\$
22.	16-Foot-Wide Drive Gate	2 EA	\$	\$
23.	3/4-Inch Rock Ground Cover at Tank Site	12,202 SQFT	\$	\$
24.	Drive Approach	351 SQFT	\$	\$
25.	Furnish And Install Building Plumbing and Drainage	Lump Sum	Not Applicable	\$
26.	Bollards	20 EA	\$	\$
27.	5-Foot Concrete Sidewalk	90 LF	\$	\$
28.	Booster Pump Pedestal	2 EA	\$	\$
29.	Pump Building Foundation	Lump Sum	Not Applicable	\$
30.	Electrical Prefabricated Building	Lump Sum	Not Applicable	\$
31.	Mechanical Room 18-Inch Adjustable Pipe Supports	2 EA	\$	\$
32.	Mechanical Room 8-Inch Adjustable Pipe Supports	2 EA	\$	\$
33.	Mechanical Room Concrete Pad Pipe Supports	2 EA	\$	\$

BID ITEM LIST

Base Bid: Orland Emergency Groundwater Resource Project - Phase 4

Item No.	Description	Approx. Quantity	Unit Price	Total Price
34.	Generator Pad Foundation	Lump Sum	Not Applicable	\$
35.	Water Tank Foundation	Lump Sum	Not Applicable	\$
36.	Meter/Main, ATS, Power Distribution	Lump Sum	Not Applicable	\$
37.	Site Electrical Materials	Lump Sum	Not Applicable	\$
38.	Variable Frequency Drive	2 EA	\$	\$
39.	PLC Panel	Lump Sum	Not Applicable	\$
40.	Utility Costs	Lump Sum	Not Applicable	\$
41.	PLC And SCADA Programming	Lump Sum	Not Applicable	\$
42.	Instrumentation	Lump Sum	Not Applicable	\$
43.	1,000 GPM Booster Pump	2 EA	\$	\$
44.	Pump Station Start Up and Testing	Lump Sum	Not Applicable	\$
45.	Ductile Iron Fittings and Appurtenances for the Booster Pump Station (BPS)	Lump Sum	Not Applicable	\$
46.	Ductile Iron Pipe Spools (BPS)	Lump Sum	Not Applicable	\$
47.	8-Inch Check Valves (BPS)	2 EA	\$	\$
48.	18-Inch Flanged Gate Valve Assembly (BPS)	1 EA	\$	\$
49.	12-Inch Flanged Gate Valve Assembly (BPS)	1 EA	\$	\$
50.	8-Inch Flanged Gate Valve Assembly (BPS)	7 EA	\$	\$
51.	Flow Control Valve Assembly (BPS)	Lump Sum	Not Applicable	\$
52.	Chlorination System and Appurtenances	Lump Sum	Not Applicable	\$
53.	Water Storage Tank	Lump Sum	Not Applicable	\$
54.	Water Storage Tank - Interior Coating	Lump Sum	Not Applicable	\$
55.	Water Storage Tank - Exterior Coating	Lump Sum	Not Applicable	\$
56.	Water Storage Tank - Appurtenances and Cathodic Protection	Lump Sum	Not Applicable	\$
57.	Water Storage Tank -12-Inch Inlet Line and Appurtenances	Lump Sum	Not Applicable	\$
58.	Water Storage Tank - 18-Inch Outlet Line and Appurtenances	Lump Sum	Not Applicable	\$
59.	Water Storage Tank - Overflow Line	Lump Sum	Not Applicable	\$
60.	Water Storage Tank - Drain Line and Valve	Lump Sum	Not Applicable	\$
BASE BID SUBTOTAL				\$

BID ITEM LIST

Additional Bid 1 Prefabricated Building

Item No.	Description	Approx. Quantity	Unit Price	Total Price
61	Prefabricated Building Extension	Lump Sum	Not Applicable	\$
ADDITIONAL 1 SUBTOTAL				\$

Additional Bid 2 Emergency Generator

Item No.	Description	Approx. Quantity	Unit Price	Total Price
62	Emergency Generator	Lump Sum	Not Applicable	\$
63	Gas Connection Complete	Lump Sum	Not Applicable	\$
ADDITIONAL 2 SUBTOTAL				\$

Bid Schedule

Bid Schedule 1 - Base Bid Subtotal (Bid items 1 through 60)	\$
Bid Schedule 2 - Base Bid plus Additional #1 Subtotal (Bid items 1 through 61)	\$
Bid Schedule 3 - Base Bid plus Additional #2 Subtotal (Bid items 1 through 60, 62 and 63)	\$
Bid Schedule 4 - Base Bid plus Additional #1 and #2 Subtotal (Bid items 1 through 63)	\$

The City will award the bid as specified in Notice to Bidders Paragraph 9.

BID ITEM LIST



LIST OF SUBCONTRACTORS

As of March 1, 2015, Contractors (and sub-contractors) wishing to bid on public works contracts must be registered with the State Division of Industrial Relations and certified to bid on Public Works contracts. Please register at <https://www.dir.ca.gov/Public-Works/Contractor-Registration.html>. The local agency will verify registration of all contractors and subcontractors on public works projects at bid and thereafter annually to assure that yearly registration is maintained throughout the life of the project.

In accordance with Title 49, Section 26.11 of the Code of Federal Regulations, and Section 4104 of the Public Contract Code of the State of California, as amended, the following information is required for each sub-contractor who will perform work amounting to more than one half of one percent (0.5%) of the Total Base Bid or \$10,000 (whichever is greater).

Photocopy this form for additional firms.

Subcontractor Name & Location	Bid Item & Description	Percentage of Bid Item Subcontracted	Contractor License Number
			DIR Reg Number
NAME			
City, State			
NAME			
City, State			
NAME			
City, State			
NAME			
City, State			
NAME			
City, State			
NAME			
City, State			
NAME			
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LIST OF SUBCONTRACTORS

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In accordance with Title 49, Section 26.11 of the Code of Federal Regulations, and Section 4104 of the Public Contract Code of the State of California, as amended, the following information is required for each sub-contractor who will perform work amounting to more than one half of one percent (0.5%) of the Total Base Bid or \$10,000 (whichever is greater).

Photocopy this form for additional firms.

Subcontractor Name & Location	Bid Item & Description	Percentage of Bid Item Subcontracted	Contractor License Number
			DIR Reg Number
NAME			
City, State			
NAME			
City, State			
NAME			
City, State			
NAME			
City, State			
NAME			
City, State			
NAME			
City, State			
NAME			
City, State			
NAME			
City, State			

LABOR CERTIFICATION

[LABOR CODE SECTION 1861]

STATE OF CALIFORNIA)
) ss
COUNTY OF _____)

I, the undersigned, do hereby certify:

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

Executed at _____

On _____.

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

Contractor-Employer

LABOR CERTIFICATION



NONCOLLUSION AFFIDAVIT

NONCOLLUSION DECLARATION TO BE EXECUTED BY
BIDDER AND SUBMITTED WITH BID

The undersigned declares:

I am the _____ of _____, the party making the foregoing bid.

The bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation. The bid is genuine and not collusive or sham. The bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid. The bidder has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or to refrain from bidding. The bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder. All statements contained in the bid are true. 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, to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof, to effectuate a collusive or sham bid, and has not paid, and will not pay, any person or entity for such purpose.

Any person executing this declaration on behalf of a bidder that is a corporation, partnership, joint venture, limited liability company, limited liability partnership, or any other entity, hereby represents that he or she has full power to execute, and does execute, this declaration on behalf of the bidder.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct and that this declaration is executed on _____ [date], at Orland, California.

Note: The above Noncollusion Affidavit is part of the bid. Signing this Bid on the signature portion thereof shall also constitute signature of this Noncollusion Affidavit. Bidders are cautioned that making a false certification may subject the certifier to criminal prosecution.

NONCOLLUSION AFFIDAVIT



BIDDER'S SIGNATURE

Accompanying this Bid is _____, (cash, cashier's check, certified check or Bidder's Bond) in the amount equal to at least 10 percent of the total amount of the Bid.

The names of all persons interested in the foregoing bid as principals are as follows:

IMPORTANT NOTICE

If Bidder is a corporation, the legal name of the corporation shall be set forth below, together with the signature of the officer or officers authorized to sign Contracts on behalf of the corporation. If Bidder is a copartnership, the true name of the firm shall be set forth below, together with the signature of the partners authorized to sign Contracts in behalf of the copartnership; and if Bidder is an individual, his signature shall be placed below. If signature is by an agent, other than an officer of a corporation or a member of a partnership, a Power of Attorney must be on file with the Owner prior to opening of Bids or submitted with the Bid; otherwise, the Bid will be disregarded as irregular and unauthorized.

The undersigned further declares that he is a licensed Contractor in the State of California, and that the license which he holds is of the class required to perform the specified work.

License No. _____ Classification(s) _____

ADDENDA - This Bid is submitted with respect to the changes to the contract documents included in addenda number(s) _____

(Fill in addenda numbers if addenda have been received and insert, in this Bid, any Engineer's Estimate sheets that were received as part of the addenda.)

By my signature on this Bid I certify that I have read and understand the clauses and certifications which are a part of this bid and that my signature shall constitute an endorsement and execution of those clauses and certifications. I further agree that in case of default in signing and returning the required Contract with necessary bonds within 14 days after receiving notice of award, the proceeds of the cash, check or bond accompanying the Bid shall be forfeited to the Owner.

BIDDER'S SIGNATURE

Date:	_____	Business P.O. Box:	_____
Name of Individual, Corporation, or Copartnership:	_____	Business Street Address:	_____
Title:	_____		<i>(Please provide even if P.O. Box used)</i>
Signature(s):	_____	City, State, Zip Code:	_____
Contractor License No.:	_____	Phone No.:	_____
DIR Registration No.:	_____	Fax No.:	_____

BIDDER'S BOND

KNOW ALL MEN BY THESE PRESENTS, THAT WE, THE UNDERSIGNED _____

_____ as Principal;

And _____ as Surety, are hereby

held and firmly bound unto _____

hereinafter called the Owner, in the sum of _____

_____ dollars (\$ _____), which sum is equal to at least 10 percent of the total amount of the Bid, payment of which sum, well and truly to be made, we hereby, jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns.

The condition of the above obligation is such that whereas the Principal has submitted to the Owner a certain Bid, attached hereto and hereby made a part thereof, to enter into a Contract in writing, for the construction of:

ORLAND EMERGENCY GROUNDWATER RESOURCE PROJECT - PHASE 4

THEREFORE,

(a) If said Bid shall be rejected, or in the alternate,

(b) If said Bid shall be accepted and the Principal shall sign and deliver a Contract, in the Form of Contract attached hereto and shall execute and deliver Performance and Payment Bonds in the forms attached hereto (all completed in accordance with said Bid), and shall in all other respects perform the agreement created by the acceptance of said Bid.

Then, this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all default of the Principal hereunder shall be the amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its bond shall be in no way impaired or affected by any extension of the time within which the Owner may accept such Bid, and said Surety does hereby waive notice of any such extension.

BIDDER'S BOND

IN WITNESS THEREOF, the above-bounded parties have executed this instrument under their several seals this _____ day of _____, 20____, the name and corporate seal of each corporate party being hereto affixed and those presents duly signed by its undersigned representative pursuant to authority of its governing body.

IN PRESENCE OF:

	_____ Individual Principal
_____ Address	_____ Business Address
_____	_____ Individual Principal
_____ Address	_____ Business Address

	_____ Corporate Principal
	_____ Business Address
_____	By _____ Affix Corporate Seal

ATTEST:

	_____ Corporate Surety
	_____ Business Address
	_____ Corporate Seal

The rate of premium on this bond is ___ per thousand.

Total amount of premium charged is \$ _____ .

FORM OF CONTRACT

THIS AGREEMENT, made and entered into on the date below written, by and between, **CITY OF ORLAND, CALIFORNIA, A MUNICIPAL CORPORATION**, 815 Fourth Street, Orland, California, 95963, hereinafter called the **OWNER**, and _____, hereinafter called the **CONTRACTOR**.

WITNESSETH, that, for the considerations hereinafter mentioned, the Owner and Contractor agree as follows:

ARTICLE I. The Contractor agrees to furnish all labor, materials, tools, and equipment and to perform all the work required to construct and complete in a good and workmanlike manner, and in strict accordance with the Contract Documents entitled:

**CONTRACT DOCUMENTS
FOR
ORLAND EMERGENCY GROUNDWATER RESOURCE PROJECT - PHASE 4**

The Contract Documents have been prepared by *GEI Consultants Inc.*, 11010 White Rock Road, Suite 200, Rancho Cordova, CA 95670, hereinafter called the Engineer, and are hereby incorporated in and made a part of this Contract.

ARTICLE II. The Owner agrees to pay the Contractor for the performance of the Contract, subject to additions and deductions provided therein, the following prices, and the Contractor agrees to receive and accept said following prices as full compensation for furnishing all materials and for doing all the work contemplated and embraced in this agreement, and for all loss or damage arising out of the nature of the aforesaid work or from the action of the elements and from any unforeseen difficulties or obstructions which may arise or be encountered in the prosecution of the work until its acceptance by the Owner, and for all risks of every description connected with the work, and for all expenses incurred by or in consequence of the suspension or discontinuance of the work, and for well and faithfully completing the work and the whole thereof in the manner and according to the Contract Documents and the requirements of the Engineer under it, to wit:

As shown on the Bid attached hereto and incorporated herein.

ARTICLE III. The Owner shall make payments on the account of the Contractor as specified in Article 6.00 of the General Conditions.

ARTICLE IV. The Contractor shall commence work within 15 days and shall diligently prosecute the same to completion within 365 working days after receipt of a Notice to Proceed from the Owner.

ARTICLE V. The Contractor shall guarantee all of his work against defective material or faulty workmanship for a period of one year after the date of acceptance of the work by the Owner.

The Contractor shall repair or replace to the satisfaction of the Owner any or all such work that may prove defective in workmanship or materials within that period, ordinary wear and tear and unusual abuse or neglect excepted, together with any other work which may be damaged or displaced in so doing.

In the event of failure to comply with the above-mentioned conditions within a reasonable time after being notified in writing, the Owner is authorized to have the defects repaired and made good at the expense of the Contractor who will pay the cost and charges therefore immediately upon demand.

FORM OF CONTRACT

The signing of the Contract by the Contractor shall constitute execution of the above guarantees.

ARTICLE VI. The Contractor specifically obligates himself and hereby agrees to protect, hold free and harmless, defend and indemnify the Owner, the Engineer and his consultants, and each of their officers, employees and agents, from any and all liability, penalties, costs, losses, damages, expenses, causes of actions, claims or judgments, including attorney's fees, which arise out of or are in any way connected with the Contractor's performance of his work under this Contract. To the extent legally permissible, this indemnity and hold harmless agreement by the Contractor shall apply to any acts or omissions, whether active or passive, on the part of the Contractor or his agents, employees, representatives, or subcontractors, or his subcontractor's agents, employees and representatives, resulting in liability irrespective of whether or not any acts or omissions of the parties to be indemnified hereunder may have also been a contributing factor to the liability.

As a further precaution toward this end, the Contractor shall procure and maintain, in full force and effect during the performance of the work contemplated hereunder, insurance in his favor and also in favor of the Owner, with an insurance carrier approved by the Owner, as specified in Article 4.00 of the General Conditions and in the Special Conditions.

ARTICLE VII. Contractor acknowledges that State Labor Law requires the payment of prevailing wages and the maintenance of certain payroll records and other requirements as specified in Article 5.00 of the General Conditions and the Labor Code. Contractor agrees that these requirements shall be incorporated into all of his subcontracts.

ARTICLE VIII. Neither party of the Contract shall assign the Contract or sublet it as a whole without the written consent of the other, nor shall the Contractor assign any monies due, or to become due to him hereunder, nor utilize any subcontractors, other than those set forth in the List of Subcontractors, without the previous written consent of the Owner.

ARTICLE IX. Contractor is an independent contractor in the performance of this contract and is not an employee or agent of the Owner. The Owner has no direct obligation to any officers, agents, employees or subcontractors of the Contractor and such individuals shall not be entitled to claim direct payment of salaries nor seek employment benefits from the Owner.

ARTICLE X. Contractor warrants that he is duly and properly licensed to perform and provide the services contemplated by this Contract. Contractor shall possess all required licenses, including a local business license and shall require subcontractors and suppliers to be similarly licensed with regard to performance under this Contract.

ARTICLE XI. The Contractor shall maintain records relating to his performance of this Contract which shall be available for audit and/or inspection for a period of three (3) years after Contractor completes performance of the Contract or the Contract is otherwise terminated.

ARTICLE XII. Any Notices given pursuant to this Contract must be in writing and given either by personal delivery or by United States Mail, postage prepaid, addressed as follows:

OWNER:

City of Orland
Attn.: Pete Carr
City Manager
815 Fourth Street
Orland, CA 95963

CONTRACTOR:

FORM OF CONTRACT

ARTICLE XIII. The Owner may terminate this Contract, without cause, upon giving of five (5) days written notice to Contractor. In the event of termination without cause, Contractor shall be compensated for services performed and materials furnished on an equitable basis through the date of termination.

ARTICLE XIV. California Law governs the interpretation and enforcement of this Contract.

ARTICLE XV. This Contract embodies the entire agreement between the parties. There are no oral agreements. No amendment to this Contract shall be valid unless in writing, executed by both parties to this Contract. The language of this Contract governs against any conflicting language or terms contained in any attachment, exhibit or scope of work.

ARTICLE XVI. Neither the acceptance of work nor payment for that work shall constitute a waiver of any provisions of this Contract. A waiver of any breach shall not constitute a waiver of any other provision or subsequent breach.

IN WITNESS WHEREOF, the parties to these presents have hereunto set their hands on the date below written.

OWNER

Date

Pete Carr
City Manager
City of Orland

(City Seal)

Attest:

Jennifer Schmitke, City Clerk, City of Orland

CONTRACTOR

Date

name

title

Approved as to Form:

company

Greg Einhorn, City Attorney
City of Orland



PERFORMANCE BOND

Whereas, The City Council of the City of _____, State of California, and _____ (hereinafter designated as "principal") have entered into an agreement whereby principal agrees to install and complete certain designated public improvements, which said agreement, dated _____, 20____, and identified as project _____, is hereby referred to and made a part hereof; and

Whereas, Said principal is required under the terms of said agreement to furnish a bond for the faithful performance of said agreement.

Now, therefore, we, the principal and _____, as surety, are held and firmly bound unto the City of _____ (hereinafter called "City"), in the penal sum of _____ dollars (\$ _____) lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, successors, executors and administrators, jointly and severally, firmly by these presents.

The condition of this obligation is such that if the above bounded principal, his or its heirs, executors, administrators, successors or assigns, shall in all things stand to and abide by, and well and truly keep and perform the covenants, conditions and provisions in the said agreement and any alteration thereof made as therein provided, on his or their part, to be kept and performed at the time and in the manner therein specified, and in all respects according to their true intent and meaning, and shall indemnify and save harmless _____, its officers, agents and employees, as therein stipulated, then this obligation shall become null and void; otherwise it shall be and remain in full force and effect.

As a part of the obligation secured hereby and in addition to the face amount specified therefor, there shall be included costs and reasonable expenses and fees, including reasonable attorney's fees, incurred by the City in successfully enforcing such obligation, all to be taxed as costs and included in any judgment rendered.

The surety hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the agreement or to the work to be performed thereunder or the specifications accompanying the same shall in anywise affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the agreement or to the work or to the specifications.

PERFORMANCE BOND

The surety's obligations to the City arise immediately upon the default of the principal, without demand or notice.

In the event the principal defaults in the performance of its obligations, the surety may elect, either directly or through appropriate contractors to perform in the place of the principal. If the surety elects to proceed in this fashion, it shall provide written notice of such election to the City within thirty (30) days after surety becomes aware of the principal's default. If the surety elects to complete the obligations of the principal (as opposed to paying money damages to the City occasioned by such breach) the surety shall cause the obligations of the principal to be performed as soon as is reasonably possible, but in no event later than nine (9) months following knowledge of the breach by the principal. In the event the surety elects to perform the principal's obligations, the City shall be entitled to compel the surety, by way of specific performance, to perform such obligations.

If the surety does not elect to perform the principals' obligations, the surety shall deposit with the City a sum equal to the cost of the uncompleted portion of the work which comprises the principal's obligation. The City's city engineer shall determine the estimated cost of the uncompleted portion of the work and the surety shall make such deposit with the City within five (5) days of receipt of the city engineer's estimate. The City shall not be required to expend any of its own funds to complete the work nor to incur "out-of-pocket" damages inasmuch as the City's damages are measured by the value of its unfulfilled right, namely the cost of completing the obligations of the principal by installing the bargained-for improvements. Upon deposit of the estimated cost of completion with the City, the City may proceed to bid the remainder of the work as a public project pursuant to the Public Contracts Code and the surety shall be obligated to continue to deposit such additional sums as may be necessary from time-to-time until the improvements are complete and accepted by the City or until the surety has exhausted the penal sum of the bond. Should the surety deposit more funds than are necessary to satisfy the principal's obligation, then the City shall refund any balance remaining upon final acceptance of the improvements. No interest shall be paid on any deposits made with the City.

Underwriting assumptions and cost estimates of the Surety shall not have any bearing, whatsoever, on the Surety's liability under this bond. By way of example, if, when making underwriting decisions regarding issuing this bond, a cost estimate was prepared regarding the principal's obligations to the City, the fact that an item was omitted from the cost estimate (which item was an obligation of the principal to the City), shall in no way defeat or diminish the Surety's obligation to the City with respect to this omitted item. By way of further example, if the underwriting decision to issue this bond included a cost estimate of items and a particular item was estimated at a cost significantly less than the amount actually required to perform such item, this fact shall in no way defeat or diminish the Surety's obligation to the City. Namely, the Surety shall be obligated, to the full amount of the penal sum of the bond, with respect to all matters

PERFORMANCE BOND

which are the principal's obligation to the City, whether such items are actually included in any cost estimate (or if so included, are estimated at a cost far less than the actual cost to perform such items). Likewise, the adequacy and amount of any premium (and whether or not such premium was sufficient for the risk assumed by Surety) shall have no bearing on Surety's absolute and unconditional obligation to the City upon the principal's default of its obligations under this bond.

In witness whereof, this instrument has been duly executed by the principal and surety above named, on

_____, 20____.

ATTEST:

	_____ Principal
	By _____
_____ (Principal Secretary)	
	_____ (Address)
_____ (Witness as to Principal)	
	_____ (Address)

ATTEST:

	_____ Surety
	By _____
_____ (Surety Secretary)	_____ Attorney-in-Fact
	_____ (Address)
_____ (Witness as to Surety)	
	_____ (Address)

NOTE: If Contractor is a Partnership, all partners should execute the bond.



PAYMENT BOND

Whereas, The City Council of the City of _____, State of California,
and _____ (hereinafter designated as "principal")

have entered into an agreement whereby principal agrees to install and complete certain designated public improvements, which said agreement, dated _____, 20____, and identified as project _____, is hereby referred to and made a part hereof; and

Whereas, Under the terms of the agreement, the principal is required before entering upon the performance of the work, to file a good and sufficient payment bond with the City of _____ to secure the claims to which reference is made in Title 3 (commencing with Section 9000) of Part 6 of Division 4 of the Civil Code.

Now, therefore, the principal and the undersigned as corporate surety, are held firmly bound unto the City of _____ and all contractors, subcontractors, laborers, material suppliers, and other persons employed in the performance of the agreement and referred to in Title 3 (commencing with Section 9000) of Part 6 of Division 4 of the Civil Code in the sum of _____

dollars (\$_____), for materials furnished or labor thereon of any kind, or for amounts due under the Unemployment Insurance Act with respect to this work or labor, that the surety will pay the same in an amount not exceeding the amount hereinabove set forth, and also in case suit is brought upon this bond, will pay, in addition to the face amount thereof, costs and reasonable expenses and fees, including reasonable attorney's fees, incurred by county (or city) in successfully enforcing this obligation, to be awarded and fixed by the court, and to be taxed as costs and to be included in the judgment therein rendered.

It is hereby expressly stipulated and agreed that this bond shall inure to the benefit of any and all persons, companies, and corporations entitled to file claims under Title 3 (commencing with Section 9000) of Part 6 of Division 4 of the Civil Code, so as to give a right of action to them or their assigns in any suit brought upon this bond.

Should the condition of this bond be fully performed, then this obligation shall become null and void, otherwise it shall be and remain in full force and effect.

The surety hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the agreement or the specifications accompanying the same shall in any manner affect its

PAYMENT BOND

obligations on this bond, and it does hereby waive notice of any such change, extension, alteration, or addition.

In witness whereof, this instrument has been duly executed by the principal and surety above named, on

_____, 20____ .

ATTEST:

	_____ Principal
	By _____
_____ (Principal Secretary)	
	_____ (Address)
_____ (Witness as to Principal)	
	_____ (Address)

ATTEST:

	_____ Surety
	By _____
_____ (Surety Secretary)	_____ Attorney-in-Fact
	_____ (Address)
_____ (Witness as to Surety)	

NOTE: If Contractor is a Partnership, all partners should execute the bond

GENERAL CONDITIONS

1.00 SCOPE OF THE WORK

1.01 INTENT

The intent of the Plans and Specifications is to prescribe the details for the construction and completion of the work which the Contractor undertakes to perform in accordance with the terms of the Contract Documents. Where the Plans or Specifications describe portions of the work in general terms, but not in complete detail, it is understood that only the best general practice is to prevail and that only materials and workmanship of the first quality are to be used. Unless otherwise specified, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals, and do all the work involved in executing the Contract in a satisfactory and workmanlike manner.

1.02 CHANGES IN THE WORK

The Owner reserves the right to make changes in the work, including alterations, additions, deductions and omissions, and to require extra work, all as may be deemed necessary by the Owner. All such changes will be done under Contract Change Order which shall set forth the work to be done or the changes to be made, the value of the work or the method by which it will be determined and the change, if any, in the time of completion of the work.

The value of any such extra work or change shall be determined in one or more of the following ways:

- (a) By unit prices named in the Contract or subsequently agreed upon.
- (b) By estimate and acceptance in an agreed upon lump sum.
- (c) By Force Account as provided for in Section 6.04.

If none of the above methods is agreed on, or if the work is to be done by Force Account, the Contractor shall keep and present in the form prescribed in Section 6.05 a correct account of the net cost of the labor and materials actually incorporated in the work.

Upon receipt of a Contract Change Order, the Contractor shall proceed with the ordered work. If ordered in writing by the Owner, the Contractor shall proceed with the work so ordered prior to actual receipt of a Contract Change Order. A Contract Change Order executed by the Contractor and approved by the Owner is an executed Contract Change Order as that term is used in Section 1.03 through 1.05.

A Contract Change Order may be issued to the Contractor at any time. Should the Contractor disagree with any terms or conditions set forth in a Contract Change Order which he has not executed, he shall submit a written protest to the Owner within 15 days after the receipt of such Contract Change Order. The protest shall state the points of disagreement, Specification references, and, if possible, the quantities and cost involved. If a written protest is not submitted, payment will be made as set forth in the Contract Change Order and such payment shall constitute full compensation for all work included therein or required thereby. Such unprotested Contract Change Orders will be considered as executed Contract Change Orders as that term is used in Section 1.03 through 1.05.

Where the protest concerning a Contract Change Order relates to compensation, the compensation payable for all work specified or required by said Contract Change Order to which such protest relates will be determined as provided in Section 1.03 through 1.05. The Contractor shall keep full and complete records of the cost of such work and shall permit the Owner to have access thereto as may be necessary to assist in the determination of the compensation payable for such work.

Where the protest concerning a Contract Change Order relates to the adjustment of time of completion of the work, the time to be allowed therefore will be determined as provided in Section 2.03.

1.03 INCREASED OR DECREASED QUANTITIES

Increases or decreases in the quantity of a Contract item of work will be determined by comparing the total pay quantity of such item of work with the quantity shown in the Proposal for the same item of work.

GENERAL CONDITIONS

If the total pay quantity of any item of work required under the Contract varies from the Proposal quantity therefore by 25 percent or less, payment will be made for the quantity of work performed at the Contract unit price, unless eligible for adjustment pursuant to Section 1.04.

If the total pay quantity of any item of work required under the Contract varies from the Proposal quantity therefore by more than 25 percent, in the absence of an executed Contract Change Order specifying the compensation to be paid, the compensation payable to the Contractor will be determined in accordance with Section 1.03A, 1.03B, or 1.03C herein, as the case may be.

1.03A INCREASE OF MORE THAN 25 PERCENT

Should the total pay quantity of any item of work under the Contract exceed the Proposal quantity by more than 25 percent, the work in excess of 125 percent of the Proposal quantity (if not covered by an executed Contract Change Order specifying the compensation) will be paid for by adjusting the Contract unit price, or at the option of the Owner, payment for the work involved in such excess will be made on the basis of Force Account as provided in Section 6.04.

The Contractor's fixed costs which have been distributed over the Proposal quantity will be deemed to have been recovered by the Contractor from the payments made for 125 percent of the Proposal quantity, and will be excluded from the adjusted unit price.

1.03B DECREASES OF MORE THAN 25 PERCENT

Should the total pay quantity of any item of work under the Contract be less than 75 percent of the Proposal quantity, the quantity performed (unless covered by an executed Contract Change Order specifying the compensation) will be paid for by adjusting the Contract unit price, or at the option of the Owner, payment for the quantity of the work of such item performed will be made on the basis of Force Account as provided in Section 6.04.

The Contractor's fixed costs which have been distributed over the Proposal quantity will be redistributed over the pay quantity in determining the adjusted unit price.

The total payment for the final quantity of such item of work will in no case exceed the payment which would be made for the performance of 75 percent of the Proposal quantity at the original Contract unit price.

1.03C DELETED ITEMS

Should any Contract item of work be deleted in its entirety (in the absence of an executed Contract Change Order covering the deletion), payment will be made to the Contractor for actual and direct costs, excluding overhead and profit, incurred prior to the date of notification in writing by the Owner of the deletion, except as provided for costs of handling materials.

If acceptable material is ordered by the Contractor for the deleted item prior to the date of notification of the deletion by the Owner, and if orders for such material cannot be canceled, it will be paid for at the actual cost to the Contractor, excluding overhead and profit. In such case, the material paid for shall become the property of the Owner and the cost of any further handling will be paid for as extra work as provided in Section 1.05. If the material is returnable to the vendor and if the Owner so directs, the material shall be returned and the Contractor will be paid for charges made by the vendor for returning the material, excluding any markup for overhead and profit to the Contractor. The cost of handling returned material will be paid for as extra work as provided in Section 1.05.

1.04 CHANGES IN CHARACTER OF WORK

If an ordered change in the Plans or Specifications materially changes the character of the work of a Contract item from that on which the Contractor based his Proposal price, and increases or decreases the actual unit cost of the changed item, an adjustment in compensation therefore will be made. Any such adjustment will apply only to the portion of the work of said item actually changed in character. At the

GENERAL CONDITIONS

option of the Owner, the work of said item or portion of said item which is changed in character will be paid for by Force Account as provided in Section 6.04.

Failure of the Owner to recognize a change in character of the work at the time the Contract Change Order is issued shall in no way be construed as relieving the Contractor of his duty and responsibility of filing a written protest within the 15-day limit.

1.05 HAZARDOUS MATERIALS

Contracts for excavations deeper than four feet are subject to the provisions of Public Contracts Code Section 7104, which addresses the discovery of hazardous materials in connection with any excavation which may be required. That section provides:

1.05A That the Contractor shall promptly, and before the following conditions are disturbed, notify the Owner, in writing, of any:

1.05A(1) Material that the Contractor believes may be material that is hazardous waste, as defined in Section 25117 of the Health and Safety Code, that is required to be removed to a Class I, Class II, or Class III disposal site in accordance with provisions of existing law.

1.05A(2) Subsurface or latent physical conditions at the site differing from those indicated.

1.05A(3) Unknown physical conditions at the site of any unusual nature, different materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract.

1.05B That the Owner shall promptly investigate the conditions, and if it finds that the conditions do materially so differ, or do involve hazardous waste, and cause a decrease or increase in the Contractor's cost of, or the time required for, performance of any part of the work shall issue a Contract Change Order under the procedures described in the Contract.

1.05C That, in the event that a dispute arises between the Owner and the Contractor whether the conditions materially differ, or involve hazardous waste, or cause a decrease or increase in the Contractor's cost of, or time required for, performance of any part of the work, the Contractor shall not be excused from any scheduled completion date provided for by the Contract, but shall proceed with all work to be performed under the Contract. The Contractor shall retain any and all rights provided either by contract or by law which pertain to the resolution of disputes and protests between the contracting parties.

1.06 EXTRA WORK

New and unforeseen work will be classed as extra work when determined by the Owner that such work is not covered by any of the various items for which there is a Contract price or by combinations of such items. In the event portions of such work are determined by the Owner to be covered by some of the various items for which there is a Contract price or combination of such items, the remaining portion of such work will be classed as extra work. Extra work also includes work specifically designated as extra work in the Plans or Specifications.

The Contractor shall do such extra work and furnish material and equipment therefore upon receipt of a Contract Change Order or other written order from the Owner, and without a Contract Change Order or other written order of the Owner, he shall not be entitled to payment for such extra work. Where such extra work is ordered by a written order other than a Contract Change Order, the Owner will, as soon as practicable, issue a Contract Change Order. The provisions in Section 1.02 shall be fully applicable to the subsequently issued Contract Change Order. Payment for extra work required to be performed pursuant to the provisions of this section, in the absence of an executed Contract Change Order, will be made by Force Account as provided in Section 6.04, or as agreed to by the Contractor and the Owner.

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1.07 GUARANTEE

The Contractor shall guarantee all of his work against defective material or faulty workmanship for a period of one year after the date of acceptance of the work by the Owner.

The Contractor shall repair or replace to the satisfaction of the Owner any or all such work that may prove defective in workmanship or materials within that period, ordinary wear and tear and unusual abuse or neglect excepted, together with any other work which may be damaged or displaced in so doing.

In the event of failure to comply with the above-mentioned conditions within a reasonable time after being notified in writing, the Owner is authorized to have the defects repaired and made good at the expense of the Contractor who will pay the cost and charges therefore immediately upon demand.

The signing of the Contract by the Contractor shall constitute execution of the above guarantees. The Contract Performance Bond shall remain in full effect during the guarantee period and will not be released until the expiration of such period.

2.00 PROGRESS AND COMPLETION OF THE WORK

2.01 PROGRESS OF THE WORK AND TIME OF COMPLETION

The Contractor shall begin work within 15 days after the issuance of the Notice to Proceed by the Owner. He shall diligently prosecute the same to completion within the number of days set forth in the Special Conditions.

2.02 LIQUIDATED DAMAGES

It is agreed by the parties of the Contract that in case all work called for under the Contract is not completed within the number of days specified in the Special Conditions, damage will be sustained by the Owner; and it is further agreed that it is, and will be, impractical and extremely difficult to ascertain and determine the actual damage which the Owner will sustain by the delay. It is therefore agreed that the Contractor will pay to the Owner the sum specified in the Special Conditions for each and every day's delay in finishing the work. The Contractor agrees to pay said liquidated damages and further agrees that the Owner may deduct the amount thereof from the monies due or to become due the Contractor under this Contract.

It is further agreed that if the work called for under the Contract is not completed within the number of days specified in the Special Conditions, the Owner shall have the right to increase the number of days or not, as he decides will best serve his interest. If the Owner decides to increase the number of days, he shall further have the right to charge the Contractor, his heirs, assigns, or sureties, and to deduct from the final payment for the work, all or any part, as he may deem proper, of the actual cost of engineering, inspection, superintendence, and other overhead expenses which are directly chargeable to the Contract and which accrue during the period of such extension, except that the cost of final surveys and preparation of the final estimate shall not be included in such charges.

2.03 DELAYS AND EXTENSIONS OF TIME

The Contractor will be granted an extension of time and will not be assessed with liquidated damages or the cost of engineering, inspection, superintendence and other overhead expenses during any delay beyond the time named for the completion of the work caused by an act of God or by the public enemy, acts of the Owner, fire, floods, epidemics, quarantine restrictions, strikes, unusual shortage of materials and freight embargoes. In the event of such delay, the Contractor shall notify the Owner in writing of the causes of delay within 10 days from the beginning of such delay, and his findings thereon shall be final.

2.04 PROGRESS SCHEDULE AND ORDER OF COMPLETION

Within 10 days after execution of the Contract, the Contractor shall submit to the Owner a progress schedule showing a breakdown of the work into at least all of its major items, and showing the proposed dates of starting and completing these items of work. This schedule shall also conform to the

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requirements for completion of portions of the work as may be specified in the Special Conditions. The Contractor shall review and, if necessary, revise the progress schedule at least once a month and in any event shall submit a current schedule to the Owner at his request at any time during the Contract period.

3.00 CONTROL OF THE WORK

3.01 ASSIGNMENT

Neither party of the Contract shall assign the Contract or sublet it as a whole without the written consent of the other, nor shall the Contractor assign any monies due, or to become due to him hereunder, without the previous written consent of the Owner.

3.01A ANTITRUST CLAIMS ASSIGNMENT

To the extent this Contract constitutes a contract or a subcontract to supply goods, services, or materials pursuant to a public works contract, the Contractor or subcontractor offers and agrees to assign to the Owner 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. Section 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, services, or materials pursuant to the public works contract or the subcontract. This assignment is made and becomes effective at the time the Owner tenders final payment to the Contractor, without further acknowledgment by the parties.

3.02 RIGHTS OF VARIOUS INTERESTS

Wherever work being done by the Owner's forces or by other contractors is contiguous to work covered by this Contract, the respective rights of the various interests involved shall be established by the Owner, to secure the completion of the various portions of the work in general harmony.

3.03 SEPARATE CONTRACTS

The Owner reserves the right to let other contracts in connection with this work. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work, and shall properly connect and coordinate his work with theirs.

If any part of the Contractor's work depends upon the work of any other contractor, the Contractor shall inspect and promptly report to the Owner any defects in such work that render it unsuitable. His failure to so inspect and report shall constitute an acceptance of the other contractor's work as fit and proper for the reception of his work except as to defects which may later develop in the other contractor's work. In addition, the Contractor shall measure work already in place and shall immediately report to the Owner any discrepancy between the executed work and that shown on the Plans.

3.04 SUBCONTRACTS

No subcontractor will be recognized as such, and all persons engaged in the work will be considered as employees of the Contractor and he will be held responsible for their work, which shall be subject to the provisions of the Contract Documents. Nothing contained in the Contract Documents shall create any contractual relation between any subcontractor and the Owner.

3.05 CONTRACT DOCUMENTS

The various parts of the Contract Documents, as defined in the Instructions to Bidders, are complementary and a requirement stated in one is as binding as though stated in all. They are intended to be cooperative and to describe and provide for a complete work.

In the event of conflict between the Instructions to Bidders and the Special Conditions, the Special Conditions shall govern. In the event of conflict between the General Conditions and the Special Conditions, the Special Conditions shall govern. In the event of conflict between the Plans and the Technical Specifications, the Technical Specifications shall govern, except that where items are shown on the Plans and are not specifically included in the Technical Specifications, the Plans shall govern.

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3.06 CITY ENGINEER'S AUTHORITY

The City Engineer is the representative of the Owner and has full authority to interpret the Contract Documents, to enforce the requirements thereof and to decide questions which arise during the course of the work. He has authority to stop the work whenever such stoppage may be necessary to insure the proper execution of the Contract. He shall also have authority to reject all work and materials which do not conform to the Contract Documents.

If at any time before the commencement or during the progress of the work, tools, plant or equipment appear to the City Engineer to be insufficient, inefficient, or inappropriate to secure the quality of work required or the proper rate of progress, the City Engineer may order the Contractor to increase their efficiency, or to improve their character, or to augment their number, or to substitute new tools, plant or equipment as the case may be, and the Contractor must conform to such order; but the failure of the City Engineer to demand such increase of efficiency, number, or improvement shall not relieve the Contractor of his obligation to secure the quality of work and the rate of progress necessary to complete the work in accordance with the Contract Documents.

In giving instructions, the City Engineer shall have authority to make minor changes in the work, not involving extra cost, and not inconsistent with the purpose of the work.

3.07 INSPECTION OF WORK

The Owner shall at all times have access to the work wherever it is in preparation or progress and the Contractor shall provide proper facilities for such access and for inspection. If the Specifications or the Engineer's instructions require any work to be specially tested or approved, the Contractor shall give the Owner a minimum of 48 hours' notice of its readiness for inspection. Inspection by the Owner will be made promptly. If any work should be covered up without approval or consent of the Owner, it must, if required by the Owner, be uncovered for examination at the Contractor's expense.

The inspection of the work or materials shall not relieve the Contractor of any of his obligations to fulfill his Contract as prescribed. Work and materials not meeting such requirements shall be made good and unsuitable work or materials may be rejected, notwithstanding that such work or materials may have been previously inspected by the Owner or that payment therefore has been included in a progress estimate.

Re-examination of questioned work may be ordered by the Owner and if so ordered, the work must be uncovered by the Contractor. If such work is found to be in accordance with the Contract Documents, the Owner will pay the cost of re-examination and replacement. If such work is not found to be in accordance with the Contract Documents, the Contractor shall pay such cost.

Projects financed in whole or in part with State or federal funds shall be subject to inspection at all times by the State or federal agency involved. Where any part of the work is being done under an encroachment permit or building permit, or is subject to State, County or municipal codes, laws or ordinances, representatives of the governing agency shall have full access to the work and shall be allowed to make any inspection or tests in accordance with such permits, codes, laws or ordinances. If advance notice of the readiness of the work for inspection by the governing agency is required, the Contractor shall furnish such notice to the appropriate agency.

3.08 SUPERINTENDENCE

The Contractor shall designate in writing before starting work, an authorized representative who shall have complete authority to represent and to act for the Contractor. Said authorized representative shall be present at the site of the work at all times while work is actually in progress on the Contract. During periods when work is suspended, arrangements acceptable to the Owner shall be made for any emergency work which may be required.

Whenever the Contractor or his authorized representative is not present on any particular part of the work where it may be desired to give direction, orders will be given by the Owner, which shall be received and

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obeyed by the superintendent or foreman who may have charge of the particular work in reference to which the orders are given.

Any order given by the Owner, not otherwise required by the Contract Documents to be in writing will, on request of the Contractor, be given or confirmed by the Owner in writing.

3.09 CHARACTER OF WORKMEN

If any subcontractor or person employed by the Contractor shall fail or refuse to carry out the directions of the Owner or shall appear to the Owner to be incompetent or to act in a disorderly or improper manner, he shall be removed immediately on the requisition of the Owner, and such person shall not again be employed on the work.

The Contractor shall at all times enforce strict discipline and good order among his employees, and shall not employ on the work any unfit person or anyone not skilled in the work assigned to him.

Neither party shall employ or hire any employee of the other party without his consent.

3.10 PLANS, SPECIFICATIONS AND INSTRUCTIONS

Unless otherwise provided in the Special Conditions, the Owner will furnish to the Contractor, free of charge, all copies of Plans and Specifications reasonably necessary for the execution of the work. He will also furnish with reasonable promptness additional instructions, either as supplemental drawings or otherwise, as may be necessary for the proper execution of the work. The Contractor shall keep one copy of all Plans and Specifications, including any Addenda and Contract Change Orders, on the work in good order available to the Owner and his representatives.

Should the Contractor be in doubt as to the meaning of any provision in the Plans and Specifications, or should he find any errors or omissions therein, or should he find any errors or omissions in the layout or staking, he shall immediately notify the Owner. The Owner will promptly investigate and will furnish the Contractor with any additional instructions as may be required.

Unless otherwise noted in the Special Conditions, upon completion of all Contract work, the Contractor shall provide the Owner with one complete set of Plans and Specifications with all "As Built" changes or modifications marked and annotated.

3.11 CONSTRUCTION STAKING

Unless otherwise noted in the Special Conditions, the Owner will set such construction stakes and marks as he determines are necessary to establish the lines and grades required for the completion of the work specified in the Contract Documents. Whenever the Contractor requires construction stakes, he shall notify the Owner of his requirements at least five days in advance of starting operations that require such stakes.

Property corners, bench marks, reference points and stakes shall be carefully preserved by the Contractor. In case such stakes or marks are destroyed or damaged, they will be replaced at the Owner's earliest convenience. The Contractor shall be charged for the cost of replacing or restoring stakes and marks which are destroyed or damaged by his operations. This charge will be deducted from any monies due or to become due to the Contractor under the Contract.

3.12 PERMITS AND REGULATIONS

Permits and licenses of a temporary nature necessary for the prosecution of the work shall be obtained by the Contractor at his expense. Unless otherwise specified in the Special Conditions, permits and licenses for permanent structures or permanent changes in existing facilities will be secured and paid for by the Owner. Copies of any permits and licenses which are obtained by the Owner will be on file at his office and will be available for inspection by the Contractor. The Contractor shall acquaint himself with, and abide by, any requirements of these documents. The Contractor shall obtain any supplemental

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agreements or bonds required by any encroachment permit, and he shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the work. If the Contractor observes that the Plans and Specifications are at variance therewith, he shall promptly notify the Owner in writing, and any necessary changes shall be adjusted as provided in the Contract Documents for changes in the work. If the Contractor performs any work, knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to the Owner, he shall bear all costs arising therefrom.

3.13 LANDS FOR WORK

The Owner and County shall provide the lands, easements and rights-of-way upon which the work under this Contract is to be done. Unless he specifically makes other arrangements, the Contractor shall confine his operations to the limits of the Owner's and County's land and to the limits of the easements and rights-of-way. The Contractor shall provide land required for the erection of temporary construction facilities and storage of his material. The Contractor is advised that if additional working space is required outside the limits of the rights-of-way provided, such additional area must be obtained directly from the property owners by the Contractor for use during the construction period. The Owner and County shall be furnished with copies of written agreements or otherwise notified in writing if additional working space is acquired.

The County shall be included in the decision-making process for any work-related decisions and/or deviations to the plans and these specifications for any work conducted within County lands, easements, and rights-of way.

3.14 SUSPENSION OF WORK

The Owner may at any time suspend the work, or any part thereof, by giving one day's notice to the Contractor in writing. The work shall be resumed by the Contractor within 10 days after the date fixed in the written notice from the Owner to the Contractor to do so. The Owner will reimburse the Contractor for expense incurred by the Contractor in connection with the work under this Contract as a result of such suspension, except that no reimbursement will be made if the suspension is due to non-conformance with the Contract Documents on the part of the Contractor. If the work or any part thereof shall be stopped by notice in writing, and if the Owner does not give notice in writing to the Contractor to resume work within 30 days of the date fixed in written notice to suspend, the Contractor may abandon the suspended portion of the work and will be entitled to payment for all work acceptably done on the abandoned portions.

3.15 THE OWNER'S RIGHT TO DO WORK

If the Contractor should neglect to prosecute the work properly or fail to perform any provision of the Contract, the Owner, after 3 days' written notice to the Contractor, may, without prejudice to any other course of action he may have, perform or have performed by other forces, all or any portion of the work and may deduct the cost thereof from the monies due or to become due the Contractor under this Contract.

3.16 THE OWNER'S RIGHT TO TERMINATE CONTRACT

If the Contractor should be adjudged bankrupt, or should make a general assignment for the benefit of his creditors, or if a receiver should be appointed because of his insolvency, or if he should persistently or repeatedly refuse or should fail to supply enough properly skilled workmen or proper materials, or if he should fail to make prompt payment to subcontractors or for materials or labor, or persistently disregard laws, ordinances or the instructions of the Owner, or otherwise be guilty of a substantial violation of any provision of the Contract, then the Owner, may, without prejudice to any other right or remedy and after giving the Contractor 7 day's written notice, terminate the employment of the Contractor and take possession of the premises and of all materials, tools, and appliances thereon and finish the work by whatever method he may deem expedient. In such case, the Contractor shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the Contract price exceeds the expenses of finishing the work, including compensation for all attributable administrative costs and for damages incurred through the Contractor's default, such excess shall be paid to the Contractor. If such expenses exceed such unpaid balance, the Contractor shall pay the difference to the Owner. The

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expenses incurred by the Owner as herein provided, and the damage incurred through the Contractor's default, shall be certified by the Owner.

3.17 REMOVAL OF EQUIPMENT

In the case of annulment of this Contract before completion for any cause, the Contractor, if notified to do so by the Owner, shall promptly remove any part or all of his equipment and supplies from the Owner's property. If not promptly done, the Owner shall have the right to remove such equipment and supplies at the expense of the Contractor.

3.18 CORRECTION OF WORK

The Contractor shall promptly remove from the premises all materials condemned by the Owner as failing to conform to the Contract Documents whether incorporated in the work or not. The Contractor shall, at his own expense, promptly replace such materials and perform all work made necessary by such replacement, including making good all work of others destroyed or damaged by such removal or replacement.

If the Contractor does not remove such condemned work and materials within a reasonable time, fixed by written notice, the Owner may remove and store the material at the expense of the Contractor. If the Contractor does not pay for the expense of the removal within 10 days' time thereafter, the Owner may, upon 10 days' written notice, sell such materials at auction or at private sales and shall account for the net proceeds thereof, after deducting all the costs and expenses that should have been borne by the Contractor.

3.19 DEDUCTIONS FOR UNCORRECTED WORK

If the Owner deems it inexpedient to correct work injured or done not in accordance with the Contract, an equitable deduction from the Contract price shall be made therefore.

3.20 USE OF COMPLETED PORTIONS

The Owner shall have the right to take possession of and use any completed or partially completed portions of the work, notwithstanding the time for completing the entire work or such portions may not have expired, but taking possession and use shall not be deemed an acceptance of any work not completed in accordance with the Contract Documents. If such prior use increases the cost of or delays the work, the Contractor shall be entitled to extra compensation, or extension of time or both, as the Owner may determine.

3.21 CONTRACTOR CLAIMS

Appropriate claims shall be submitted and reviewed in accordance with Section 20104 of the Public Contracts Code. For any claim subject to this Section, the following requirements apply:

3.21A The claim shall be in writing and include the documents necessary to substantiate the claim. Claims must be filed on or before the date of final payment. Nothing in this subdivision is intended to extend the time limit or supersede notice requirements otherwise provided in the Contract for the filing of claims.

3.21B(1) For claims of less than fifty thousand dollars (\$50,000), the Owner shall respond in writing to any written claim within 45 days of receipt of the claim, or may request, in writing, within 30 days of receipt of the claim, any additional documentation supporting the claim or relating to defenses to the claim the Owner may have against the Contractor.

3.21B(2) If additional information is thereafter required, it shall be requested and provided pursuant to this subdivision, upon mutual agreement of the Owner and the Contractor.

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3.21B(3) The Owner's written response to the claim, as further documented, shall be submitted to the Contractor within 15 days after receipt of the further documentation or within a period of time no greater than that taken by the Contractor in producing the additional information, whichever is greater.

3.21C(1) For claims of over fifty thousand dollars (\$50,000) and less than or equal to three hundred seventy-five thousand dollars (\$375,000), the Owner shall respond in writing to all written claims within 60 days of receipt of the claim, or may request, in writing, within 30 days of receipt of the claim, any additional documentation supporting the claim or relating to defenses to the claim the Owner may have against the Contractor.

3.21C(2) If additional information is thereafter required, it shall be requested and provided pursuant to this subdivision, upon mutual agreement of the Owner and the Contractor.

3.21C(3) The Owner's written response to the claim, as further documented, shall be submitted to the Contractor within 30 days after receipt of the further documentation, or within a period of time no greater than that taken by the Contractor in producing the additional information or requested documentation, whichever is greater.

3.21D If the Contractor disputes the Owner's written response, or the Owner fails to respond within the time prescribed, the Contractor may so notify the Owner, in writing, either within 15 days of receipt of the Owner's response or within 15 days of the Owner's failure to respond within the time prescribed, respectively, and demand an informal conference to meet and confer for settlement of the issues in dispute. Upon a demand, the Owner shall schedule a meet and confer conference within 30 days for settlement of the dispute.

3.21E Following the meet and confer conference, if the claim or any portion remains in dispute, the Contractor may file a claim as provided in Chapter 1 (commencing with Section 900) and Chapter 2 (commencing with Section 910) of Part 3 of Division 3.6 of Title 1 of the Government Code. For purposes of those provisions, the running of the period of time within which a claim must be filed shall be tolled from the time the Contractor submits his or her written claim pursuant to subdivision (a) until the time that claim is denied as a result of the meet and confer process, including any period of time utilized by the meet and confer process.

3.21F This article does not apply to tort claims and nothing in this article is intended nor shall be construed to change the time periods for filing tort claims or actions specified by Chapter 1 (commencing with Section 900) and Chapter 2 (commencing with Section 910) of Part 3 of Division 3.6 of Title 1 of the Government Code.

It is hereby mutually agreed that the Contractor shall not be entitled to payment of additional compensation for any cause, including any act or failure to act by the Owner, or of any event, thing or occurrence, unless he shall have given the Owner due written notice of potential claim, provided however, that compliance with this Section shall not be a prerequisite as to matters within the scope of the protest provisions in Section 1.02, nor to any claim which is based on differences in measurements or errors of computation of Contract quantities.

The written notice of potential claim shall set forth the reasons the Contractor believes additional compensation will or may be due, the nature of the costs involved, and, insofar as possible, the amount of the potential claim. The required notice must have been given to the Owner prior to the time the Contractor performed the work giving rise to the potential claim for additional compensation, if based on an act or failure to act by the Owner, or in all other cases within 15 days after the event, thing or occurrence giving rise to the potential claim.

In the event of an emergency endangering life or property, the Contractor shall act as stated in Section 4.04, and after execution of the emergency work, shall present an accounting of labor, materials, and

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equipment in connection therewith. The procedure for any payment that may be due for emergency work will be as specified in Section 1.02.

The City Engineer shall, within a reasonable time after their presentation to him, state his decisions in writing on all claims of the Owner or the Contractor. All such decisions of the City Engineer shall be final.

It is the intention of this Section that differences between the parties arising under and by virtue of the Contract be brought to the attention of the City Engineer at the earliest possible time so that such matters may be settled, if possible, or other appropriate action promptly taken. The Contractor hereby agrees that he shall have no right to additional compensation for any claim that may be based on any act, failure to act, event, thing or occurrence for which no written notice of potential claim was filed.

3.22 CLEANING UP

The work area shall be kept in a neat and orderly condition during construction. The Contractor shall remove and dispose of all trash, debris and waste material resulting from his operations. The Contractor shall, at his own expense, promptly remove from the Owner's property, and from all other lands affected by his work, all temporary structures, rubbish and waste materials resulting from his operations. He shall leave such lands in a neat and orderly condition which is at least as good as the condition prior to his operations.

4.00 INSURANCE AND LIABILITY

4.01 CONTRACTOR'S LIABILITY INSURANCE

The Contractor shall maintain insurance to protect him from claims under workman's compensation acts and from any other claims for damages for personal injury, including death, which may arise from operations under this Contract, whether such operations are controlled by him, a subcontractor or by anyone directly or indirectly employed by either of them. The Owner and County shall be named as coinsured in all such insurance policies and the coverage shall include concurrent negligence of the Owner and County or their agents, employees, or representatives whether such concurrent negligence be active or passive, including specifically any liability based upon a violation of any non-delegable duties. Certificates of insurance and the certificate required by Labor Code Section 1861 shall be filed with the Owner and County prior to commencing the work and shall be subject to their approval for adequacy of protection.

The Contractor specifically obligates himself and hereby agrees to protect, hold free and harmless, defend and indemnify the Owner, the Engineer and his consultants, and each of their officers, employees and agents, from any and all liability, penalties, costs, losses, damages, expenses, causes of actions, claims or judgments, including attorney's fees, which arise out of or are in any way connected with the Contractor's performance of his work under this Contract. To the extent legally permissible, this indemnity and hold harmless agreement by the Contractor shall apply to any acts or omissions, whether active or passive, on the part of the Contractor or his agents, employees, representatives, or subcontractors, or his subcontractor's agents, employees and representatives, resulting in liability irrespective of whether or not any acts or omissions of the parties to be indemnified hereunder may have also been a contributing factor to the liability.

As a further precaution toward this end, the Contractor shall procure and maintain, in full force and effect during the performance of the work contemplated thereunder, insurance in his favor and also in favor of the Owner, with an insurance carrier approved by the Owner, as follows:

Liability for Personal Injury or Property Damage in the amount of \$1,000,000.00 for any occurrence.

The Contractor shall, before the commencement of the work, take out and maintain in full force and effect, compensation insurance with an insurance carrier or carriers under an insurance policy or policies, satisfactory to the Owner covering his full liability under the "Worker's Compensation Insurance and

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Safety Act" of the State of California to any employee who may be injured during the course of said work and to the dependents of any employee who may be killed during the course of said work.

Such policy or policies shall expressly provide therein that they shall not be canceled by the insurer until 10 days after written notice of the intended cancellation thereof shall have first been given to the Owner by the insurer.

The Contractor shall file with the Owner, immediately after the signing of the Contract, certificates of all insurance. These certificates shall be fully executed and shall state that the policies cannot be canceled until 10 days after written notification of such intent of cancellation has been given to the Owner. All policies shall be with Insurance Companies acceptable to the Owner.

In case of the breach of any provision of this Section, the Owner may take out and maintain at the expense of the Contractor such insurance as the Owner may deem proper and may deduct the cost of such insurance from any monies which may be due or become due the Contractor under this Contract.

4.02 FIRE INSURANCE

Fire Insurance is not required for this project.

4.03 PRESERVATION OF PROPERTY

The Contractor shall take whatever precautions necessary to prevent damage to all existing improvements, including aboveground and underground utilities, trees and shrubbery that are not specifically shown to be removed, fences, signs, mail boxes, survey markers and monuments, building and structures, the Owner's property, adjacent property and any other improvements or facilities within or adjacent to the work. If such improvements or property are injured or damaged by the Contractor's operations, they shall be replaced or restored, at the Contractor's expense, to a condition at least as good as the condition prior to the start of the Contractor's operations.

The Contractor shall examine all bridges, culverts, and other structures over which he will move his materials and equipment, and before using them, he shall properly strengthen such structures, where necessary. The Contractor will be held responsible for any and all injury or damage to such structures caused by his operations.

The fact that any pipe or other underground facility is not shown, or not accurately shown on the Plans, shall not relieve the Contractor of his responsibility under this Section. It shall be the Contractor's responsibility to ascertain the existence of any underground improvements or facilities which may be subject to damage by his operations.

4.04 PROTECTION OF WORK

The Contractor shall continuously maintain adequate protection of all his work from damage. He shall make good any such damage, injury or loss, except as may be directly due to errors in the Contract Documents or caused by agents or employees of the Owner. He shall adequately protect adjacent property as provided by law and the Contract Documents. He shall provide and maintain all passage-ways, guard fences, lights and other facilities for protection required by public authority or local conditions.

In an emergency affecting the safety of life or of the work or of adjoining property, the Contractor, without special instruction or authorization from the Owner, is hereby permitted to act at his discretion to prevent such threatened loss or injury, and he shall so act without appeal if so instructed or authorized. Any compensation claimed by the Contractor for emergency work shall be determined as specified under Section 1.02.

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4.05 PUBLIC SAFETY

The Contractor shall be responsible for furnishing and maintaining all flagmen, warning signs, barricades, emergency lighting, shoring, etc. necessary to protect the public and workmen employed on the project. Safety provisions shall conform to all applicable federal, State, County and local laws, ordinances and codes and, in particular, to the rules and regulations established by OSHA, the California Division of Industrial Safety, and the California Manual on Uniform Traffic Control Devices.

4.06 ACCIDENTS

The Contractor shall provide at the site such equipment and medical facilities as are necessary to give first-aid service to anyone who may be injured.

The Contractor must promptly report in writing to the Owner all accidents arising from or in connection with the performance of the work on or adjacent to the site, giving full details and statements of witnesses. If death or serious injuries or serious damages are caused, the accident shall be reported immediately by telephone or messenger to both the City Engineer and the Owner.

If any claim is made against the Contractor or any subcontractor because of any accident, the Contractor shall promptly report the facts in writing to the Owner, giving full details of the claim.

5.00 LABOR AND MATERIALS

5.01 HOURS OF LABOR

The Contractor shall forfeit, as penalty to the Owner, \$25.00 for each workman employed in the execution of the Contract by him, or by any subcontractor under him, for each calendar day any workman is required or permitted to labor more than 8 hours in violation of the provisions of the Labor Code and in particular, Section 1810 to Section 1817 thereof, inclusive.

5.02 EMPLOYMENT OF APPRENTICES

The Contractor's attention is directed to Section 1777.5 of the Labor Code; provisions of said section pertaining to employment of indentured apprentices are hereby incorporated by reference into these Specifications. As applicable, the Contractor or any subcontractor employed by him in the performance of the Contract work shall take such actions as necessary to comply with the provisions of said Section 1777.5.

5.03 LABOR DISCRIMINATION

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

"No discrimination shall be made in the employment of persons upon public works because of the race, color or religion of such persons and every contractor for public works violating this section is subject to all the penalties imposed for a violation of this chapter."

5.04 PREVAILING WAGE

The Contractor shall forfeit as penalty to the Owner, \$50.00 for each calendar day or portion thereof, for each workman paid less than stipulated prevailing rates for any work done under the Contract by him or by any subcontractor under him, in violation of the provisions of the Labor Code and in particular, Section 1770 to Section 1780 thereof, inclusive.

The Owner will not recognize any claim for additional compensation because of the payment by the Contractor of any wage rate in excess of the Prevailing Wages set forth in the Contract Documents. The possibility of wage increases is one of the elements to be considered by the Contractor in determining his Bid, and will not be considered as the basis of a claim against the Owner on the Contract.

The Contractor and each Subcontractor shall keep an accurate record showing the name, address, social security number, work classification, straight time and overtime hours worked each day and week and the

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actual per diem wages paid to each journeyman, apprentice, worker or other employee by him or her in connection with the work. These payroll records shall be certified and made available for inspection at all reasonable hours at the principal office of the Contractor and furnished by the Contractor to the Owner and others upon request in accordance with the provisions of Labor Code Section 1776. The Contractor's attention is called to the penalties provided for in Section 1776 for the failure to comply with its provisions.

5.05 MATERIALS

Unless otherwise specifically stated in the Special Conditions, the Contractor shall furnish all materials necessary for the execution and completion of the work. Unless otherwise specified, all materials shall be new and shall be manufactured, handled, and installed in a workmanlike manner to ensure completion of the work in accordance with the Contract Documents. The Contractor shall furnish satisfactory evidence as to the kind and quality of materials.

Where materials are to be furnished by the Owner, the type, size, quantity and location at which they are available will be stated in the Special Conditions.

In certain instances, the Owner may have available power, water or other utilities or materials which the Contractor may wish to use. If the Owner intends to furnish these free of charge, it will be so stated in the Special Conditions. In the absence of such specific statement, the Contractor shall furnish all utilities and materials at his own expense.

5.06 RECORDS OF MATERIALS PURCHASED

If required by the Owner, the Contractor shall furnish duplicate invoices to the Owner for all materials furnished to the project.

5.07 PATENTS

The Contractor shall assume all costs arising from the use of patented materials, equipment, devices, or processes used on or incorporated in the work, and agrees to indemnify and save harmless the Owner and the Engineer from all suits at law, or actions of every nature for, or because of the use of any patented materials, equipment, devices, or processes.

5.08 OWNERSHIP OF REMOVED MATERIALS

Unless otherwise specifically stated in the Special Conditions or Technical Specifications, any existing equipment or material removed by the Contractor during the course of the work shall remain the property of the Contractor.

5.09 SUBSTITUTION OF MATERIALS

Where materials and equipment are specified in the Technical Specifications or are shown on the Plans as similar and equal to a certain proprietary brand, the intent is to establish the minimum quality and performance acceptable. If the Contractor proposes to substitute materials or equipment of another proprietary brand but of equal quality, he may submit a request to the Engineer for approval of the proposed substitution. No substitution may be made without prior approval and the Engineer shall be the final judge of equality.

If any tests are necessary for evaluation of the proposed substitution by the Engineer, the Contractor shall furnish all necessary test materials and shall pay the cost of the tests.

5.10 SHOP DRAWINGS AND MATERIAL DATA

Unless otherwise specifically stated in the Special Conditions or Technical Specifications, the Contractor shall submit a minimum of four separately bound copies of shop drawings and material data to the City Engineer for approval. A complete submittal shall include all drawings and data sheets for all bid item materials and all necessary appurtenances to provide a complete installation of each material. These drawings shall show any necessary details in fabrication or erection, which are not shown on the Plans furnished by the Owner and shall verify details and dimensions of equipment. **Facsimile submittals will**

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not be accepted. Material and/or equipment shall not be fabricated, assembled, or shipped until the shop drawings or material data have been approved by the City Engineer. The Contractor shall verify these dimensions before starting any work dependent on or affected by them.

The City Engineer will retain three copies of the shop drawings and material data, and will return one copy to the Contractor. If the Contractor desires additional copies, more than four copies must be submitted.

5.11 TESTS

Unless otherwise specified in the Special Conditions, the Owner will pay for the required testing of materials. The Contractor will furnish all samples at no cost to the Owner. In the event samples are submitted which fail to pass the specified tests, the Contractor will pay for all subsequent tests. The cost of such re-testing will be deducted from payments due the Contractor.

6.00 MEASUREMENT AND PAYMENT

6.01 MEASUREMENT OF QUANTITIES

Where the Contract provides for payment on a lump sum price basis, no measurement of quantities will be made. Where the Contract provides for payment on a unit price basis, the quantities of work performed will be computed by the Owner on the basis of measurements taken by the Owner, and these measurements shall be final and binding.

All work computed under the Contract shall be measured by the Owner according to United States Measurements and Weights. Methods of measurement are specified in the Special Conditions and in the Technical Specifications.

6.02 SCOPE OF PAYMENT

The Contractor shall accept the compensation, as full payment for furnishing all labor, materials, tools, equipment, and incidentals necessary to the completed work and for performing all work contemplated and embraced under the Contract; also for loss or damage arising from the nature of the work, from the action of the elements, or from any unforeseen difficulties which may be encountered during the prosecution of the work until the acceptance by the Owner and for all risks of every description connected with the prosecution of the work, also for all expenses incurred in consequence of the suspension or discontinuance of the work; and for completing the work according to the Contract Documents. Neither the payment of any estimate nor any retained percentage shall relieve the Contractor of any obligation to make good any defective work or material.

No compensation will be made for loss of anticipated profits. Increased or decreased work involving supplemental agreements will be paid for as provided in such agreements.

6.03 CHANGES IN THE WORK

The value of changes in the work, including extra work, shall be determined in accordance with Section 1.02 through 1.05.

6.04 FORCE ACCOUNT PAYMENT

Where work is to be paid for by Force Account, the Contractor shall be paid on the basis of the actual cost of labor, material, and equipment, furnished by him as shown on paid vouchers, plus 15 percent. However, the Owner reserves the right to furnish such materials and equipment as he deems expedient, and the Contractor shall have no claim for overhead and profit on the cost of such material and equipment.

The cost of labor as referred to above shall include the cost of the base wages paid to workmen, plus any additional payment paid to, or on behalf of, workmen as required by State or federal laws plus any benefits, subsistence and travel allowance as may be required by collective bargaining agreements.

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The cost of material as referred to above shall be the net cost to the purchaser, whether Contractor, subcontractor or other forces, from the supplier thereof.

The cost of equipment as referred to above, shall conform to current equipment rental rates as determined by the California State Transportation Agency's Department of Transportation, Division of Construction. This applies to both rental equipment and equipment owned by the Contractor.

6.05 RECORDS OF FORCE ACCOUNT WORK

The Contractor shall maintain his records in a manner to provide a clear distinction between the direct costs of extra work paid for on a Force Account basis and the costs of other operations. The Contractor shall furnish the Owner report sheets in duplicate of each day's extra work no later than the working day following the performance of the work. The daily report sheets shall itemize the materials used, and shall cover the direct cost of labor and the charges for equipment rental, whether furnished by the Contractor, subcontractor, or other forces. The daily report sheets shall provide names or identifications and classifications of workmen, the hourly rate of pay and hours worked, and also the size, type and identification number of equipment and hours operated.

Material charges shall be substantiated by valid copies of vendor's invoices. Such invoices shall be submitted with the daily report sheets, or if not available, they shall be submitted with subsequent daily report sheets. Should vendor's invoices not be submitted within 15 days after acceptance of the work, the Owner reserves the right to establish the cost of such material at the lowest current wholesale prices at which the materials are available in the quantities concerned delivered to the location of the work.

Said daily report sheets shall be signed by the Contractor or his authorized agent.

The Owner will compare his records with the daily report sheets furnished by the Contractor, make any necessary adjustments, and compile the costs of work paid for on a Force Account basis on daily extra work report forms. When these daily extra work reports are agreed upon and signed by both parties, they shall become the basis of payment for the work performed.

6.06 PAYMENTS WITHHELD

The Owner may withhold or, because of subsequently discovered evidence, nullify the whole or a part of any payment to such extent as may be necessary to protect himself from loss due to:

- a. Defective work not remedied.
- b. Claims filed or reasonable evidence indicating probable filing of claims.
- c. Failure of the Contractor to make payments properly to subcontractors or for material or labor.
- d. A reasonable doubt that the Contract can be completed for the balance then unpaid.
- e. Damage to another Contractor.

When the above grounds are removed, payment shall be made for amounts withheld because of them.

The Contractor may, in accordance with the provisions of Public Contracts Code Section 22300, substitute securities for any monies which the Owner may withhold to insure performance under this Contract.

6.07 PROGRESS PAYMENTS

Once each month, the City Engineer will make an estimate in written form of the total amount of work done and of the acceptable materials furnished and delivered by the Contractor on the site and not used to the time of such estimate, and the value thereof. To assist the City Engineer in determining the value of acceptable materials which are on hand but not used, the Contractor shall furnish the City Engineer with copies of invoices for all such materials. The Owner shall retain 5 percent of such estimated value of work done, and 50 percent of the value of materials so estimated to be on hand but not used.

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This retention will serve as part security for the fulfillment of the Contract by the Contractor. The Owner shall pay monthly to the Contractor the balance not retained of the aforesaid, after deducting there from all previous payments and all sums to be retained.

When in the judgment of the City Engineer, the work is not proceeding in accordance with the provisions of the Contract, or when in his judgment the total amount of the work done since the last estimate amounts to less than \$1,000.00, no pay estimate will be prepared and no progress payment will be made.

No estimates or payment shall be construed to be an acceptance of any defective work or improper materials.

The Contractor may, in accordance with the provisions of Government Code Section 4590, substitute securities for any monies which the Owner may withhold to insure performance under this Contract.

6.08 FINAL PAYMENT

Within 10 days after the completion of the work and its acceptance by the Owner, the City Engineer will make a final estimate in writing of the quantities of work done and the value thereof, and will prepare a Notice of Completion to be filed by the Owner. At this time, a semi-final payment will be made to the Contractor provided that such payment is warranted under the terms of Section 6.07. The amount of this payment shall be based on the total value of work acceptably performed under the Contract, subject to the same conditions and retentions as payments previously made under the monthly estimates.

Within 20 days after the date of the final estimate, the Contractor shall submit to the City Engineer either his written approval of the final quantities, and value of work as determined by the City Engineer, or a written statement of any and all claims for additional compensation claimed to be due under the Contract. No claim for which a notice of potential claim is required will be considered unless the Contractor has complied with the notice provisions of Section 3.21, nor will any claim be considered that was not included in said written statement of claims.

Failure of the Contractor to submit claims within the specified 20-day period, regardless of whether or not he files written approval, shall constitute his acceptance of the quantities and value of work determined by the City Engineer in the final estimate. No claim will be considered if filed after the specified 20-day period.

In the event the Contractor files claims within the specified 20-day period, the City Engineer will, within 10 days after receipt of said claims, consider and investigate the Contractor's claims and make his final determination. Should he find any revision to be warranted as a result of his investigation, the City Engineer will immediately notify the Owner and the final pay estimate will be revised accordingly.

Thirty-five days after the date of filing the Notice of Completion, the Owner will pay the entire sum found to be due, after deducting all previous payments and all amounts to be retained under the provisions of the Contract. As a condition of such payment, the Owner may require the Contractor to furnish a release of all claims against the Owner arising by virtue of the Contract. Payment will be withheld for any contract items for which a release is not furnished.

All prior partial estimates and payments shall be subject to correction in the final estimate and payments.

6.09 PAYMENT OF TAXES

The Contract prices paid for the work include full compensation for payment of federal, State or local taxes.

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1.00 SCOPE OF THE WORK

1.01 GENERAL WORK DESCRIPTION

The work to be done under this Contract consists of the installation of a 1-million gallon welded steel water storage tank, installation of 2 new booster pumps and associated electrical and instrumentation, construction of prefabricated metal structure, connecting to the existing City water system and installing site water main piping, storm drain piping and appurtenances and connecting to the new water main. new storm drain system, and associated site work.

ORLAND EMERGENCY GROUNDWATER RESOURCE PROJECT - PHASE 4

The intent of these contract documents is to provide for a completed work, and all items incidental and appurtenant to the specified items shall be included in the prices bid for the specified items.

1.02 DEFINITION OF TERMS

Wherever the words "City" or "Owner" appear in these documents, they shall be understood to mean the City of Orland, California.

Wherever the word "Contractor" appears in these documents, it shall be understood to mean the party or parties constructing the improvements for acceptance by the Owner.

Wherever the word "County" appears in these documents, it shall be understood to mean Glenn County, California.

Wherever the words "Department" or "DWR" appear in these documents, they shall be understood to mean the Department of Water Resources of the State of California.

Wherever the words "Drawings" or "Project Drawings" appears in these documents, it shall be understood to mean "Plans."

Whenever the word "Engineer" appears in these documents, it shall be understood to mean *GEI Consultants, Inc.*, Rancho Cordova, CA.

Wherever the words "City Engineer" or "City of Orland Representative" appear in these documents, they shall be understood to mean *Rolls, Anderson & Rolls*, Chico, California, acting either directly or through duly authorized agents.

Wherever the word "Landowner" appears in these documents, it shall be understood to mean the owner of the parcel upon which the Work will be constructed.

Wherever the words "Standard Detail(s)" appear in these documents, they shall be understood to mean the City of Orland Land Division Standards and Improvement Standards.

Wherever the words "USBR" or "Bureau of Reclamation" appear in these documents, they shall be understood to mean United States Bureau of Reclamation Department of the Interior.

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1.03 SPECIFICATIONS AND PLANS

The work embraced herein shall be done in accordance with the current edition of City of Orland Land Division Standards and Improvement Standards, current edition of State of California Standard Specifications, current edition of State of California Standard Plans, and these Special Conditions. References to the State of California Standard Specifications include material and workmanship specifications only. All measurement and payment sections of the State of California Standard Specifications are specifically **NOT** included in these Specifications.

Should a conflict arise between the City of Orland Land Division Standards and Improvement Standards and the Special Conditions, the Special Conditions shall govern.

Should a conflict arise between the Standard Specifications and the Special Conditions, the Special Conditions shall govern.

Should a conflict arise between the General Conditions and the Special Conditions, the Special Conditions shall govern.

Where Standard Specifications or testing methods have been referred to, such as ASTM or AASHTO, the intent is to refer to the latest applicable issue or revision of such specifications or testing methods.

2.00 PROGRESS AND COMPLETION OF THE WORK

2.01 AWARD OF CONTRACT

Refer to Section 8.00 of the Instructions to Bidders. The Award of Contract, if made, will be made within 30 days of the opening of Bids.

2.02 TIME OF COMPLETION

The Contractor shall diligently prosecute the work to completion within 365 WORKING DAYS from the issuance of the Notice to Proceed by the Owner.

2.03 LIQUIDATED DAMAGES

The Contractor shall pay to the Owner the sum of \$1,100.00 per day, for each and every calendar day's delay in finishing the work in excess of the number of calendar days prescribed above.

3.00 CONTROL OF THE WORK

3.01 PREVAILING WAGE

The successful bidder shall post a copy of the applicable wage rates on the job site during the construction period. Contractors and subcontractors shall submit certified payrolls to the Department of Industrial Relations in accordance with State of California requirements.

3.02 PERMITS AND LICENSES

No permits will be issued by the Owner for this work. It shall be the responsibility of the Contractor to secure all permits and licenses necessary, as well as pay all fees required for the completion of the work. The Contractor shall comply with all laws and regulations applicable to the work.

3.03 COORDINATION

The Owner, County, and public utility companies reserve the right to enter upon the work for the purpose of making changes necessitated by the improvements being constructed under this Contract. The Owners of the public utilities will coordinate such work with the Contractor and all parties shall cooperate to the fullest extent possible.

The Contractor shall protect from damage all utilities and other facilities that are to remain in place, be installed, relocated or otherwise rearranged.

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3.04 SHOP DRAWINGS AND MATERIAL DATA

The Contractor shall provide shop drawings and material data, in accordance with the General Conditions, to the City Engineer within 15 days of the execution of the contract. Complete submittal packages shall be reviewed and approved prior to the issuance of the Notice to Proceed.

For this project submittals shall include, but not be limited to, mix designs, pipe materials, pipe joint details, special fittings or adaptors, imported bedding and backfill materials, and all technical design data required by the Engineer to verify product compliance with the Contract Documents.

3.05 UNDERGROUND SERVICE ALERT (USA)

The Contractor shall notify the Underground Service Alert at least 48 hours before excavating.

3.06 EXISTING UTILITIES

Existing underground utilities are indicated on the drawings, based upon record information. The depths of existing utilities are unknown. The Contractor shall verify the exact locations in the field to avoid damage to existing facilities.

The Contractor shall cooperate with utility companies in locating facilities and shall exercise care in working adjacent to or crossing such facilities to avoid damage. Any damage to existing facilities caused by the Contractor's operation shall be repaired by the Contractor at his expense.

3.07 RIGHTS OF WAY

The Contractor shall confine his operations to the limits of the rights-of-way provided. The Contractor is advised that if additional working space is required outside the limits of the rights-of-way provided, such additional area must be obtained directly from the property owners by the Contractor for use during the construction period. The Owner shall be furnished with copies of **written** agreements or otherwise notified **in writing** if additional working space is acquired.

3.08 HOURS OF OPERATION

The Contractor shall restrict his activities to the hours between 7:00 a.m. and 5:00 p.m. Monday through Friday, unless otherwise approved by the Owner.

3.09 NOISE CONTROL

All equipment used by the Contractor shall have noise muffling devices approved for use in residential areas.

3.10 DUST CONTROL

Where dust is created, either by the Contractor's vehicles or other vehicles, it shall be controlled by the Contractor through watering or preferably by cleaning up the material causing the dust. Dust control shall be continued as necessary until the work is accepted by the Owner.

3.11 PREVENTION OF WATER POLLUTION AND PREVENTION OF AIR POLLUTION

The Contractor shall prepare and submit to the Engineer a Storm Water Pollution Prevention Plan (SWPPP) within 10 calendar days after the Notice to Proceed is issued. The SWPPP shall include at a minimum the following BMPs:

- 1) Establish an erosion control perimeter around active construction and Contractor layout areas including silt fencing, jute netting, straw wattles, or other appropriate measures to control sediment from leaving the construction area.
- 2) Stockpiled soils shall be watered, covered, or otherwise managed to prevent loss due to water and wind erosion.
- 3) Install containment measures at fueling stations and at fuel and chemical storage sites.
- 4) Employ good house-keeping measures including clearing construction debris and waste materials at the end of each day.

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The Contractor shall maintain a copy of SWPPP onsite at all times and shall abide by the SWPPP throughout the duration of the Project. It will be the Contractor's responsibility to:

- 1) Obtain, on behalf of the Owner, a Construction Storm Water Permit from the State Water Resources Control Board online via their website including the payment of all fees;
- 2) Submit all the reports to maintain compliance; and
- 3) Close out the Permit upon completion of the Work.

Additionally, the Contractor shall take measures as necessary to effect water pollution control. Construction operations shall be so conducted as to prevent discharge of wastes and pollutants into surface waters and underground water sources. Such water pollution control measures shall be directed toward eliminating discharge, or averting accidental spillage, of such industrial and domestic wastes as oils, gasses, fuels, sewage, toxic materials, and other substances which may be hazardous to public health and welfare or harmful to fish and wildlife. The Contractor shall be responsible for compliance with the applicable State and local regulations for prevention and abatement of pollution of surface and underground water. The Contractor's pollution control methods shall be subject to approval of the Engineer. The Owner shall have the right to require the Contractor, at his expense, to initiate and maintain such pollution control measures as deemed necessary to eliminate pollution of water caused by or resulting from the Contractor's operation. No separate payment will be made for prevention of water pollution, the costs for all work and materials required under this paragraph shall be borne by the Contractor.

The Contractor shall prepare and submit to the Engineer and all appropriate parties, a Site dust control and PM-10 Dust Management Plan within 10 calendar days after the Notice to Proceed is issued. The Contractor shall maintain a copy of said plan onsite at all times. The Contractor shall take measures as necessary to effect air pollution control.

Construction operations shall be so conducted as to prevent generation of fugitive dust and dispersion of pollutants into the air. Such air pollution control measures shall be directed toward eliminating particulates and potentially toxic or harmful materials from becoming airborne and polluting the air, as these airborne substances may be harmful to public health and/or harmful to wildlife. The Contractor shall be responsible for compliance with the applicable State, Glenn County Air Pollution Control District and local regulations for prevention and abatement of pollution of the air and any associated reporting requirements. The Contractor's pollution control methods shall be subject to approval of the Engineer as well as applicable governmental entities with regulative power over air quality. The Owner shall have the right to require the Contractor, at his expense, to initiate and maintain such pollution control measures as deemed necessary to eliminate pollution of air (and/or nuisance or fugitive dust) caused by or resulting from the Contractor's operation. No separate payment will be made for prevention of air pollution, the costs for all work and materials required under this paragraph shall be borne by the Contractor.

3.12 CONSTRUCTION WATER

The Owner will furnish water for dust control, cleaning operations, and testing from the Owner's existing system. No charge will be made for such water. However, it shall not be used wastefully, and it shall be the Contractor's responsibility to see that it is delivered to the place it is needed. The Contractor shall make a written request to the City of Orland Public Works Department for the installation of a hydrant meter prior to beginning work. The Contractor shall only use water from hydrants that have been fitted with hydrant meters. The Contractor shall furnish and use only proper hydrant wrenches when obtaining water from fire hydrants. No fire hydrant shall be obstructed in case of fire in the area served by the hydrant.

3.13 SANITATION

The Contractor shall provide temporary sanitation facilities at the work site, and maintain such facilities throughout the period of work on the project.

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3.14 TESTING

All required testing of materials and construction methods will be provided by the Owner. Should tests show materials or methods to be unacceptable, however, and re-testing of the same material is required, the cost of such re-testing will be deducted from payments due the Contractor.

3.15 LANDSCAPE RESTORATION

All landscaping and irrigation facilities disturbed by the work shall be restored to its original condition by the Contractor. Any irrigation facilities in conflict with proposed improvements shall be replaced, repaired or relocated and tested by the Contractor. Testing of the irrigation facilities shall be done while the Public Works Director or his representative is present.

The Contractor shall take care to minimize damage to adjacent landscaping. Sod shall be installed where established grass has been removed. The Contractor shall restore landscaping as trenching and backfilling operations are completed. Restored landscaping shall be watered and maintained for thirty (30) days after placement.

No measurement of quantities will be made. Payment for restoring landscaping to existing conditions or as specified by the Engineer shall be included in the prices bid for the Bid Items.

3.16 OWNERSHIP OF REMOVED OR SURPLUS MATERIAL

Excavated concrete structures, pipe, iron and asphalt shall become the property of the Contractor, and removed from the site.

Miscellaneous construction materials, debris, rubble, backfill screenings, or deleterious material not suitable for backfill shall become the property of the Contractor, and removed from the site.

3.17 CLEANUP

The work area shall be kept in a neat and orderly condition during construction. The Contractor shall remove and dispose of all trash, debris and waste material resulting from his operations.

Upon completion of the work, the Contractor shall remove all debris, surplus material, equipment and supplies, and shall leave the entire work area in a neat, orderly condition.

3.18 TEMPORARY TRENCH RESURFACING

At the end of the workday, the work area shall be secured to prevent pedestrians from entering/driving into open trenches or other potentially dangerous environments. The Contractor shall provide temporary trench resurfacing, as necessary, throughout the project in compliance with the City Standards, County Standards, and as specified in the contract documents.

Alternatively, the Contractor may cover excavations within the street area subject to traffic loads with steel plating. The steel plating shall be of a thickness adequate to withstand the traffic loads that may be imposed and securely anchored at all times with temporary pavement to prevent displacement of the plate by traffic vibration.

4.00 WORK ZONE SAFETY

4.01 POLICY

The Contractor shall be solely responsible for safety on the job. Inspection of the work being performed or acceptance of work completed does not imply any approval or acceptance by the Owner of safety measures used by the Contractor.

The Contractor shall furnish, erect, and maintain at all times, substantial barricades, fences, signs, or other adequate protection.

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The Contractor shall furnish, erect, and maintain at all times adequate sheeting, shoring, and bracing of all excavations in accordance with OSHA and California Industrial Safety Regulations. The Contractor shall be **solely** responsible for the adequacy and sufficiency of the safety equipment used.

The work shall be carried out in an orderly and systematic manner to present as little inconvenience as possible to public traffic. A minimum of one traffic lane shall be maintained on adjacent streets at all times.

5.00 INSURANCE REQUIREMENTS

5.01 GENERAL

The Contractor shall procure and maintain for the duration of the Contract insurance against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the work hereunder by the Contractor, his agents, representatives, employees or subcontractors. The cost of such insurance shall be included in the Contractor's bid.

5.02 MINIMUM SCOPE OF INSURANCE

Coverage shall be at least as broad as:

General Liability and Umbrella or Excess Liability Insurance covering all operations by or on behalf of the Contractor providing insurance for bodily injury liability, and property damage liability for the limits of liability indicated below and including coverage for premises, operations and mobile equipment; products and completed operations; broad form property damage (including completed operations); explosion, collapse and underground hazards; personal injury; and contractual liability.

Automobile Liability Insurance, including coverage for all owned, hired and non-owned automobiles.

Workers' Compensation Insurance as required by the State of California and Employer's Liability insurance.

5.03 MINIMUM LIMITS OF INSURANCE

The Contractor shall maintain no less than:

1. General Liability:
 - a) \$1,000,000.00 per occurrence (combined a single limit for bodily injury and property damage).
 - b) \$2,000,000.00 aggregate for products-completed operations.
 - c) \$2,000,000.00 general aggregate. This general aggregate limit shall apply separately to the Contractor's work under this Contract.
 - d) \$5,000,000.00 umbrella or excess liability. Umbrella or excess policy shall include products liability and completed operations coverage. Further, the umbrella or excess policy shall contain a clause stating that it takes effect (drops down) in the event the primary limits are impaired or exhausted.
2. Automobile Liability: \$1,000,000.00 combined single limit each accident for bodily injury and property damage. The umbrella or excess liability coverage required above shall also apply to automobile liability.
3. Employers Liability:

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- a) \$1,000,000.00 per accident for bodily injury by accident.
- b) \$1,000,000.00 policy limit for bodily injury by disease.
- c) \$1,000,000.00 for each employee for bodily injury by disease.

5.04 DEDUCTIBLES AND SELF-INSURED RETENTIONS

Any deductibles or self-insured retentions must be declared to and approved by the City. At the option of the City, either the insurer shall reduce or eliminate such deductibles or self-insured retention as respects the City, its officers, officials, employees, agents and volunteers; or the Contractor shall procure a bond guaranteeing payment of losses and related investigations, claim administration and defense expenses.

5.05 OTHER INSURANCE PROVISIONS

The general liability and automobile liability policies are to contain, or be endorsed to contain, the following provisions:

1. The Engineer, City Engineer, Department, County, and City (including its officers, officials, employees, agents and volunteers) are to be covered as insureds as respects: liability arising out of activities performed by or on behalf of the Contractor; products and completed operations of the Contractor; premises owned, leased or used by the Contractor; or automobiles owned, leased, hired or borrowed by the Contractor. The coverage shall contain no special limitations on the scope of protection afforded to the Engineer, City Engineer, Department, County, and City (including its officers, officials, employees, agents and volunteers).
2. For any claims related to this project, the Contractor's insurance coverage shall be primary insurance as respects the Engineer, City Engineer, Department, County, and City (including its officers, officials, employees, agents and volunteers). Any insurance or self-insurance maintained by the Engineer, City Engineer, Department, County, and City (including its officers, officials, employees, agents and volunteers) shall be excess of the Contractor's insurance and shall not contribute with it.
3. Any failure to comply with reporting or other provisions of the policies including breaches of warranties shall not affect coverage provided to the Engineer, City Engineer, Department, County, and City (including its officers, officials, employees, agents and volunteers).
4. Coverage for such additional insureds shall not extend to liability:
 - a) arising from any defective or substandard condition of a City/County roadway which existed prior to the time the Contractor commenced work, unless such condition has been changed by the work or the scope of the work requires the Contractor to maintain existing City/County roadway facilities and the claim arises from the Contractor's failure to maintain; or,
 - b) for claims occurring after the work is completed and accepted unless these claims are directly related to alleged acts or omissions of the Contractor which occurred during the course of the work; or,
 - c) to the extent prohibited by Section 11580.04 of the Insurance Code.
5. The Contractor's insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.
6. Each insurance policy required by this clause shall be endorsed to state that coverage shall not be suspended, voided, canceled by either party, reduced in coverage or in limits except after

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thirty (30) days prior written notice by certified mail, return receipt requested, has been given to the City of Orland.

5.06 WORKERS COMPENSATION AND EMPLOYERS LIABILITY COVERAGE

The insurer shall agree to waive all rights of subrogation against the Engineer, City Engineer, Department, County, and City (including its officers, officials, employees, agents and volunteers) for losses arising from work performed by the Contractor for the City.

5.07 ACCEPTABILITY OF INSURERS

Insurance is to be placed with insurers that are acceptable to the City of Orland.

5.08 VERIFICATION OF COVERAGE

Contractor shall furnish the City with original endorsements affecting coverage required by this clause. The endorsements are to be signed by a person authorized by that insurer to bind coverage on its behalf. The endorsements are to be on forms provided by the City and all endorsements are to be received and approved by the City before work commences. As an alternate to the City's forms, the Contractor's insurer may provide complete, certified copies of all required insurance policies, including endorsements affecting the coverage required by these specifications.

5.09 SUBCONTRACTORS

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

If the Contractor fails to maintain such insurance, the City may take out such insurance to cover any damages, for which the City might be held liable on account of the operations under this contract, and deduct and retain the amount of the premiums for such insurance from any sums due the Contractor under this contract. Nothing herein contained shall be construed as limiting in any way the extent to which the Contractor may be held responsible for payment of damages resulting from his operations, or those of any subcontractor under him.

5.10 NO PERSONAL LIABILITY

Contractor shall indemnify and hold harmless Engineer, City Engineer, Department, County, and City (including its officers, officials, employees, agents and volunteers) from and against claims, damages, losses and expenses including attorney fees arising out of the performance of the work described herein, caused in whole or in part by any negligent act or omission of the Contractor, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, except where caused by the active negligence, sole negligence, or willful conduct of the City.

APPENDIX A

CERTIFICATE OF INSURANCE



Return Completed Certificate to
 City of Orland
 815 Fourth Street
 Orland, CA 95963

CERTIFICATE OF INSURANCE
TO
CITY OF ORLAND
CALIFORNIA ("the City")
A Municipal Corporation

Only this Certificate
 of Insurance form
 will be accepted

This certifies to the City that the following described policies have been issued to the Insured named below are in force at this time.

Insured _____
 Address _____

Description of operation/locations/products insured (shown contract name and/or number, if any): _____

POLICIES AND INSURERS	LIMITS Bodily Injury Property Damage	POLICY NUMBER	EXPIRATION DATE
Worker's Compensation _____ (Name of Insurer) Best's Rating _____	Employer's Liability \$ _____		
Check policy type: Comprehensive General Liability _____ or Commercial General Liability _____ _____ (Name of Insurer) Best's Rating _____	"Claims Made" _____ "Occurrence" _____ Each Occurrence Each Occurrence \$ _____ \$ _____ Or Combined Single Limit \$ _____ Aggregate \$ _____		
Business Auto Policy Liability Coverage Symbol _____ _____ (Name of Insurer) Best's Rating _____	Each Person \$ _____ Each Accident \$ _____ or Combined Single Limit \$ _____		
Umbrella Liability _____ (Name of Insurer) Best's Rating _____	"Claims Made" _____ "Occurrence" _____ Occurrence/ Aggregate \$ _____ Self-Insured Retention \$ _____		

The following coverage or conditions are in effect:	Yes	No
The City, its officials, and employees are named on all liability policies described above as insureds as respects: (a) activities performed for the City by or on behalf of the named insured, (b) products and completed operations of the Named Insured, and (c) premises owned, leased or used by the Named Insured.		
Products and Completed Operations		
The undersigned will mail to the City 30 days' written notice of cancellation or reduction of coverage or limits.		
Cross Liability Clause (or equivalent wording)		
Personal injury, Perils A, B, and C		
Broad Form Property Damage		
X, C, U Hazards included		
Contractual Liability Coverage applying to this Contract		
Liquor Liability		
Coverage afforded the City, its officials, employees and volunteers as Insureds applies as primary and not excess or contributing to any insurance issued in the name of the City.		
Waiver of subrogation from Workers' Compensation Insurer.		
Environmental Liability Insurance		

All of the above policies expressly provide therein that they shall not be canceled by the insurer until 30 days written notice of the intended cancellation thereof has first been given to the City of Orland by the insurer.

Agency or Brokerage

Address

Name of Person to be Contacted

Telephone Number

Insurance Company

Home Office

Authorized Signature

Date

Note: Authorized signatures may be the agent's if agent has placed insurance through an agency agreement with the insurer. If insurance is brokered, authorized signature must be that of official of insurer.

TECHNICAL SPECIFICATIONS



PART 1 GENERAL

1.01 MOBILIZATION

- A. Mobilization shall consist of preparatory work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the site; for the establishment of all facilities necessary for work on the Project; and for all other work and operations which must be performed, or costs incurred prior to beginning work, on the various items on the Project site.
- B. Mobilization includes:
 - 1. Construction of temporary access ways, temporary fencing, temporary signage, and temporary facilities.
 - 2. Moving in and setting up the Contractor's area.
 - 3. Obtaining all necessary construction permits.
 - 4. Necessary site barricades.
 - 5. Sanitary facilities.
 - 6. Dust control.
 - 7. Traffic control.
 - 8. Other facilities and controls as may be required by the local building official.
 - 9. Cleaning and removing the Contractor's equipment from the work area at the completion of the project.
- C. See the Technical Specification titled "**Measurement and Payment**" for additional items that are included in mobilization.

1.02 DEMOBILIZATION

- A. Demobilization shall consist of work and operations necessary to disband all mobilized items and clean up the site. The removal of all temporary access ways, signs, temporary fencing, and temporary facilities, equipment or works and the restoration of surfaces to an equal or better than existing condition shall also be included as part of demobilization.
- B. See the Technical Specification titled "**Measurement and Payment**" for additional items that are included in demobilization.

1.03 CONTRACTOR RESPONSIBILITY

- A. The Contractor must be responsible for furnishing all labor, equipment, supplies, and materials necessary to perform all operations required for Project completion and for establishing, maintaining, and providing security for the Project site for the duration of the Project.

1.04 RESTRICTIONS IN WORK AREA

- A. Confine all work to the area inside easements and public right of way of City of Orland owned property.

- B. The Caltrans and Glenn County right-of-way shall be used only for purposes that are necessary to perform the required work. The Contractor shall not occupy the right-of-way, or allow others to occupy the right-of-way, for purposes that are not necessary to perform the required work.
- C. Do not store materials, supplies, or other items outside the designated work area or on private property.
- D. Do not park equipment or vehicles outside the designated work area or on private property.
- E. Access to private residences shall not be restricted at any time.

1.05 STAGING AREAS AND ALTERNATIVE STAGING AREAS

- A. The Contractor must coordinate with the Engineer for locations of staging and Project administration offices. By making the sites available to the Contractor, the City, the property Owner, and any other person or agency connected with the properties must in no way be responsible or liable for any activity of the Contractor, Subcontractors, or any individual or organization connected with the work of the Contractor.
- B. If alternative sites are determined to be necessary, they must be near the Project and the Contractor must make all arrangements including but not limited to, clearance of archeological and environmental sites for their use at the Contractor's expense and must be reviewed by the Engineer prior to use. The Contractor must provide the Engineer with written approvals and agreements from the legal property Owner prior to use of alternate staging area sites.

1.06 SPECIAL REQUIREMENTS

- A. The Contractor must comply with all other applicable provisions of the Contract Documents, including but not limited to, restoration of landscape to original conditions. Unless specifically designated for removal, existing trees in staging areas must not be removed. If construction of ramps, berms or other features is necessary, the Contractor must be responsible for the import and disposal of such material and the restoration of the site to its original condition.

1.07 FLOODING

- A. In the event of potential flooding of the site or at the direction of the Engineer, the Contractor must remove all vehicles and other mobile equipment, fuels, and soluble materials within four (4) hours of notification.

1.08 SITE GRADING

If site grading is performed at staging or access areas, the site must be restored to the original grade and vegetated condition at completion of the Work, unless otherwise directed by the Engineer, or Owner.

1.09 SUBMITTALS

- A. The Contractor shall submit a Mobilization and Demobilization Plan that includes the following:
 - 1. Provide a list of equipment and facilities to be included in the mobilization and demobilization process.
 - 2. All required permits.

3. Requirements identifying space for temporary structures.
4. Location and approximate size of mobile and stationary equipment.
5. Storage of materials.
6. Layout for all temporary offices, sanitary facilities, storage buildings, storage yards, temporary water service and distribution, and temporary power service and distribution.
7. Should the Contractor require space in addition to that available on-site, the Contractor must make arrangements for storage of materials and equipment in locations off the construction site at the Contractor's own expense.

1.10 UNDERGROUND UTILITIES

- A. The Contractor is responsible for calling Underground Service Alert at 811 forty-eight (48) hours prior to any excavating and trenching work. The Contractor is responsible for marking on the ground the location of the excavated area.
- B. The Contractor is responsible for identifying all existing underground piping, cables, or any other facilities, and if damaged, immediately repair piping at no cost to the Owner or the City.
- C. The location, pipe diameter and elevations of underground utilities shown on the Drawings are approximate and based on limited available as-builts only. The Contractor shall contact all utility companies so that those companies may mark the locations of their lines prior to construction. This includes all utility services/laterals to properties. The Contractor shall coordinate inspection, clearance, and other requirements with each utility company prior to construction. The Contractor shall protect the existing utilities and field verify the location and depth of existing utilities prior to construction.

PART 2 PRODUCTS

2.01 MATERIAL STORAGE

- A. The Contractor shall provide buildings or shelters at the site as required for material storage for protection against the elements, theft, or other damage. The buildings must be of sufficient size and so arranged or partitioned to provide security for their contents and provide ready access for inspection and inventory.

2.02 UTILITIES

- A. If necessary, the Contractor shall provide required temporary power, heat, or any other item necessary to conduct operations needed in the Work.

2.03 CONTRACTOR'S FACILITIES

- A. The Contractor's temporary facilities shall conform to the Technical Specification titled "**Temporary Facilities and Controls.**"
- B. The Contractor shall be responsible for its construction material and equipment storage area in the vicinity of the Project. The use of alternate locations or sites will require prior approval by the City.

1. All such sites shall be maintained to the satisfaction of the Engineer so as to not create a public nuisance during or after their use. In the event the Contractor requires space for the storage and/or staging of construction materials, supplies, equipment, stockpiling of debris, or any other needs required for construction operations, he/she shall acquire at his/her own expense such areas as he/she may desire.
 2. The storage area shall be enclosed at the Contractor's expense with construction fencing covered with a mesh screen to limit visibility to the site. City-designated areas for storage of construction material or debris shall be restored to a legal condition with regard to appearance and maintenance upon conclusion of the Project. The property shall be graded and free of weeds and debris when the Project is completed.
- C. The Contractor shall provide separate sanitary facilities. The Contractor is responsible for maintaining facility in a sanitary condition.
- D. The Contractor shall place all necessary and required safety and control signs.

2.04 DRINKING WATER

- A. The Contractor shall provide drinking water or bottled water for all personnel connected with the Work. The Contractor shall transport water in such a manner as to keep it clean and fresh, and serve from single service containers with paper cups or sanitary drinking fountains.

2.05 WATER FOR CONSTRUCTION PURPOSES

- A. Water for Construction Purposes shall be in accordance with the Technical Specification titled **“Temporary Facilities and Controls.”**

2.06 TEMPORARY TOILETS

- A. The Contractor shall provide adequate chemical toilet facilities for all individuals connected with the Work, in number as required by Federal and State Safety and Occupational Standards and at locations convenient for use. The Contractor shall keep the toilet facilities in sanitary condition. The Contractor shall remove the toilet facilities at completion of construction and disinfect premises. The toilets must be regularly maintained, cleaned, and drained.

2.07 ELECTRICAL LIGHT AND POWER

- A. The Contractor shall provide temporary light and power service as required for the Work and to inhibit vandalism. The Contractor shall provide safety switches and wiring into buildings and all required extension cords, lighting outlets, power outlets (grounded type), lamps and other equipment and accessories necessary for adequate temporary lighting and power for construction purposes. The Contractor shall remove temporary lighting and power and their connections at completion of the Work.

2.08 BARRICADES, RAILING AND PROTECTION

- A. The Contractor shall provide barricades, railing (Type K), temporary fencing, handrails, shoring and other devices required by law and as necessary to protect new construction and materials and to protect all persons on the Job site.

PART 3 EXECUTION

3.01 REQUIREMENTS

- A. The Contractor must furnish, install, service and maintain for the duration of the Project the personnel, material, and equipment necessary to complete all work described in Section 1.01.

3.02 CODES

- A. All facilities installed under this section must meet the requirements of all the applicable state, county and federal codes and regulations.

3.03 PROJECT ACCESS

- A. Project Access shall be in accordance with the Technical Specification titled "**Temporary Facilities and Controls.**"



PART 1 GENERAL

1.01 SCOPE

- A. This section specifies the safety requirements and regulations which may affect the Contractor's operations at the water storage tank. Such requirements and regulations are in addition to the requirements set forth in the drawings and other sections of the contract documents.

1.02 RELATED SECTIONS

- A. Supplementary General Conditions, General Conditions, Special Conditions, and Drawings apply to this section.

1.03 REFERENCES

- A. The following publications form a part of this Specification to the extent referenced.
 - 1. California Code of Regulations (CCR):
 - a. Title 8, Subchapter 4, Article 37 Confined Spaces in Training for all workers entering a confined space.

1.04 CONFINED SPACE ENTRY

- A. The Contractor shall prepare and disseminate among those performing the work at the work site a written program for Confined Space Entry and Permit Required Confined Space Entry that conform to CCR Title 8, Subchapter 4, Article 37 Confined Spaces in Construction.
- B. Contractor's workers shall have Confined Space Training and shall provide documentation of such training.
- C. The Contractor shall periodically meet with the Engineer to review Confined Space Entry practices at the work site, as they affect Department employees and the public. Promptly after each meeting, revisions of the Confined Space Entry Program shall be prepared, submitted, and disseminated, as specified for the original program.

PART 2 MATERIALS

2.01 NOT USED

PART 3 EXECUTION

3.01 TRAINING

- A. Confined Space:
 - 1. The employer shall provide training to each employee and ensure that the employee possesses the understanding, knowledge, and skills necessary for the safe performance of the duties assigned under this standard.

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2. This training shall result in an understanding of the hazards in the confined space and the methods used to isolate, control or in other ways protect employees from these hazards, and in the dangers of attempting rescues when not properly trained to conduct such rescues.

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

- A. All measurements will be based on the actual completed work performed in strict accordance with the specifications.

- B. Payment items for the work of this contract for which contract lump sum payments and unit price payments will be made are listed in the bid schedule and described below. All costs for items of work, which are not specifically mentioned to be included in a particular job or unit price payment item, are to be included in the listed job item most closely associated with the work involved. The unit price and payment made for each item listed constitutes full compensation for furnishing all labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests, and reports, and for performing all work required for which separate payment is not otherwise provided.

- C. The Contractor shall submit a Schedule of Values that represents the cost of the Work for each lump sum bid item with a value over \$5,000. The breakdown shall not exceed the lump sum value for that bid item. The Schedule of Values shall be approved prior to submitting the first progress payment, whether or not the request for payment includes any lump sum items. The Schedule of Values shall be broken down into separate work activities that adequately describe the work, with a cost associated with each activity. The minimum detail of each breakdown shall be a cost for; materials freight on board, installation, testing and acceptance. The Schedule of Values shall not be used to determine the value of deleted or changed work, but shall be used solely for determining the value of progress payments in accordance with the General Conditions.

1.02 BASE BID ITEM DESCRIPTIONS

BID ITEM 1. Mobilization/Demobilization

- 1. Description:
 - a. Mobilization shall include all activities and costs for transportation of personnel, equipment, and operating supplies to and from the site; establishment of portable sanitary and refuse facilities; location, provision and installation of field offices & equipment/materials, storage yards, excavation equipment, buildings, and other necessary facilities for the Contractor's operations at the site; premiums paid for performance and payment bonds, including coinsurance and reinsurance agreements as applicable; temporary project signage; developing and providing construction water supply, pre-construction audio video survey, construction survey, and as-built project documents.

 - b. Demobilization shall include all activities and costs for transportation of personnel, equipment, and supplies not included in the contract from the site; including the disassembly, removal and site cleanup of offices, equipment, buildings, grading of storage and staging areas, restoration of facilities, roads, fences, facilities etc. modified or

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disturbed during the course of the project and other facilities assembled on the site for this contract.

- c. The Contractor will be responsible to provide his own security for equipment, materials, fuel, tools, etc. that he may have on site.
- d. The Contractor shall provide all necessary equipment & materials; all tools, accessories, power, fuel, materials, supplies, lighting, water, and other support equipment; and experienced personnel necessary to execute the work in an orderly an efficient manner.
- e. Bid item also includes all items necessary to complete the Project that are not covered under any other Bid Item.

2. **Measurement:** The Owner makes partial payments for Mobilization/Demobilization costs which shall adhere to Public Contract Code § 10264, modified as follows, and not to exceed the following:

- a. When 5 percent of the original contract amount is earned, 20 percent of the amount bid may be paid.
- b. When 10 percent of the original contract amount is earned, 40 percent of the amount bid may be paid.
- c. When 20 percent of the original contract amount is earned, 60 percent of the amount bid may be paid.
- d. When 50 percent of the original contract amount is earned, 80 percent of the amount bid may be paid.
- e. When 100 percent of the original contract amount is earned, 100 percent of the amount bid may be paid.

3. **Payment:** Payment for Mobilization/Demobilization will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete Mobilization/Demobilization as required by these specifications.

BID ITEM 2. Environmental Compliance

1. **Description:** The Contractor shall comply with all local, state and federal requirements for the Storm Water Pollution Prevention Program, site dust control, and other environmental compliance items identified in the General and Special Conditions. The Contractor shall install, maintain, and remove all necessary measures to comply with the requirements of the applicable regulatory agencies. The Contractor shall also keep necessary documentation to prove compliance with said requirements. It will be the Contractor's responsibility to 1) obtain, on behalf of the City, a Construction Storm Water Permit from the State Water Resources Control Board online via their website; 2) submit all the reports to maintain compliance; and 3) close out the Permit upon completion of the Work.

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The Contractor is responsible for fees associated with all environmental compliance permits.

2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, permits, fees, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications in addition to including all the work involved in water pollution control, completely, including all inspections, reporting, and removal of water pollution control items as specified in these Technical Specifications.

BID ITEM 3. Site Management

1. **Description:** Site Management shall include all activities and costs for providing a traffic control plan, obtaining the City of Orland encroachment permits, additional permits, temporary gates and fences, barricades, signs, traffic control measures, and other safety measures to control vehicular traffic on access routes through the work site and at the work site during the project.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, permits, fees, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 4. Project Identification Sign

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to furnish and install a Project Identification Sign. This includes, but is not limited to, furnishing and installing the project identification sign per the contract plans and specifications (including adequate structural supports) and any other labor, materials, transportation, supplies, tools, and equipment necessary to complete the Work. Work will include project sign installation, maintenance throughout the duration of the project, and removal and disposal at the end of the project.
2. **Measurement:** Bid Item will be paid on a per unit price basis and will be measured per individual Project Identification Sign installed.
3. **Payment:** Payment for the Project Identification Sign Bid Item will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete installation of the project identification sign as shown, as required by these specifications, and as directed by the Owner.

BID ITEM 5. Demolition, Clearing, and Grubbing

1. **Description:** The Contractor shall clear and grub the entire area enclosed by the project fee parcels and temporary and permanent easements, which includes demolition, disposal, hauling, clearing, grubbing, and stripping as required to

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install and/or remove and dispose of all items as necessary to complete the Work.

2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 6. Potholing and Utility Coordination –Site

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, traffic control, excavation, backfill, compaction, roadway resurfacing, and incidentals required to determine the locations, size, material, and depths of all existing underground utilities and tie-in locations for the proposed water pipelines and storm drain in accordance with the Specifications and Plans. This item shall include all necessary coordination with the City of Orland, Orland Unit Water Users Association, USBR, Landowners, utility companies, and Glenn County and complying with their requirements.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 7. Water System Tie-in Connection

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to connect to the existing City water system pipelines. The connection to the existing City water system on the tank site. This includes, but is not limited to, coordinating with the City for system shutdown, confirming existing pipeline material, location, and size, furnishing and installing couplings and fittings as needed to make connection, removing and replacing existing pipe thrust restraint, temporary pipe thrust restraint, repair of existing coating and lining, hardware, and any other labor, materials, transportation, supplies, tools, and equipment necessary to complete the Work. The Contractor shall perform all necessary coordination and testing. All components required to make a connection are part of this bid item.
2. **Measurement:** Bid Item will be paid on a per unit price basis and will be measured per individual water system tie-in connection performed.
3. **Payment:** Payment for the Water System Tie-in Connection Bid Item will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the water system tie-in connection to the City water system as shown and required by these specifications.

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BID ITEM 8. 12-inch Restrained Class 350 Ductile Iron Pipe (DIP) -Watermain

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to furnish and install the fully restrained 12-inch Class 350 DIP and the connection to the City water system. This Bid Item includes, but is not limited to, the procurement and installation of all pipe, fittings, couplings, polyethylene encasement, locating wire, buried piping locator tape, and appurtenances. The Contractor shall perform all activities, including but not limited to; excavation, shoring, subgrade preparation, bedding preparation, laying of pipe, installation of thrust blocks and/or joint restraints, backfill and compaction. The Contractor is responsible for the procurement of backfill material that meets the criteria presented in these specifications and plans. The City will perform compliance testing of the trench backfill. The Contractor is required to coordinate with the City for all compliance testing.
 - a. Connection to the 12-inch ductile iron pipe completed by others shall be paid under this bid item.
2. **Measurement:** Bid Item will be paid on a per linear foot basis and will be measured per linear foot of pipeline installed.
3. **Payment:** Payment for the 12-inch DIP will be made at the linear foot price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete installation of the water pipeline as shown and required by these specifications.

BID ITEM 9. 18-inch Restrained Class 350 Ductile Iron Pipe (DIP) -Watermain

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to furnish and install the fully restrained 18-inch Class 350 DIP. This Bid Item includes, but is not limited to, the procurement and installation of all pipe, fittings, couplings, polyethylene encasement, locating wire, buried piping locator tape, and appurtenances. The Contractor shall perform all activities, including but not limited to; excavation, shoring, subgrade preparation, bedding preparation, laying of pipe, installation of thrust blocks and/or joint restraints, backfill and compaction. The Contractor is responsible for the procurement of backfill material that meets the criteria presented in these specifications and plans. The City will perform compliance testing of the trench backfill. The Contractor is required to coordinate with the City for all compliance testing.
2. **Measurement:** Bid Item will be paid on a per linear foot basis and will be measured per linear foot of pipeline installed.
3. **Payment:** Payment for the 18-inch DIP will be made at the linear foot price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete installation of the water pipeline as shown and required by these specifications.

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BID ITEM 10. 12-inch Buried Flexible Expansion Joint

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to furnish and install the 12-inch buried flexible expansion joint. This Bid Item includes, but is not limited to, the procurement and installation of the buried flexible expansion joint per the requirements of the specifications and approved submittal.
2. **Measurement:** Bid Item will be paid on a per unit cost and will be measured per individual 12-inch buried flexible expansion joint installed.
3. **Payment:** Payment for the 12-inch buried flexible expansion joint will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete installation of the buried flexible expansion joint as shown and required by these specifications.

BID ITEM 11. 18-inch Buried Flexible Expansion Joint

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to furnish and install the 18-inch buried flexible expansion joint. This Bid Item includes, but is not limited to, the procurement and installation of the buried flexible expansion joint per the requirements of the specifications and approved submittal.
2. **Measurement:** Bid Item will be paid on a per unit cost and will be measured per individual 18-inch buried flexible expansion joint installed.
3. **Payment:** Payment for the 18-inch buried flexible expansion joint will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete installation of the buried flexible expansion joint as shown and required by these specifications.

BID ITEM 12. Hydrostatic Pressure Testing and Disinfection of Site Piping and Pump Station

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to perform hydrostatic pressure testing and perform disinfection of the constructed project pressurized site pipelines and pump station, which includes, but is not limited to, coordination with the City and County, temporary bulkheads and valves, isolation of sections to be tested, flushing, filling, venting, and disposal of water in a legal manner.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 13. 18-inch X 18-inch Concrete Vault

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to furnish and install the 18-inch X 18-inch Concrete Vault. This Bid Item includes, but is not limited to, the procurement and installation of precast concrete vault, steel grating, and other incidentals. The Contractor shall perform all activities, including but not limited to; excavation, shoring, subgrade preparation, bedding preparation, installation of concrete vaults, backfill, and compaction. The Contractor is responsible for the procurement of backfill material that meets the criteria presented in these specifications and plans. The City will perform compliance testing of the backfill. The Contractor is required to coordinate with the City for all compliance testing. Contractor shall provide all required material for connecting to the proposed vaults to make a leak free connection per the Specifications.
2. **Measurement:** Bid Item will be paid on a per unit price basis and will be measured per individual vault installed.
3. **Payment:** Payment for the Bid Item will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by these specifications.

BID ITEM 14. 36-inch X 36-inch Concrete Vault

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to furnish and install the 36-inch X 36-inch Concrete Vault. This Bid Item includes, but is not limited to, the procurement and installation of precast concrete vault, steel grating, and other incidentals. The Contractor shall perform all activities, including but not limited to; excavation, shoring, subgrade preparation, bedding preparation, installation of concrete vaults, backfill, and compaction. The Contractor is responsible for the procurement of backfill material that meets the criteria presented in these specifications and plans. The City will perform compliance testing of the backfill. The Contractor is required to coordinate with the City for all compliance testing. Contractor shall provide all required material for connecting to the proposed vaults to make a leak free connection per the Specifications.
 - a. The connection of the 21-inch PVC storm pipe completed by others shall be paid under this bid item.
2. **Measurement:** Bid Item will be paid on a per unit price basis and will be measured per individual vault installed.
3. **Payment:** Payment for the Bid Item will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by these specifications.

BID ITEM 15. 36-inch X 60-inch Concrete Vault

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to furnish and install the 36-inch X 60-inch Concrete Vault. This Bid

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Item includes, but is not limited to, the procurement and installation of precast concrete vault, steel grating, and other incidentals. The Contractor shall perform all activities, including but not limited to; excavation, shoring, subgrade preparation, bedding preparation, installation of concrete vaults, backfill, and compaction. The Contractor is responsible for the procurement of backfill material that meets the criteria presented in these specifications and plans. The City will perform compliance testing of the backfill. The Contractor is required to coordinate with the City for all compliance testing. Contractor shall provide all required material for connecting to the proposed vaults to make a leak free connection per the Specifications.

2. **Measurement:** Bid Item will be paid on a per unit price basis and will be measured per individual vault installed.
3. **Payment:** Payment for the Bid Item will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by these specifications.

BID ITEM 16. 21-inch PVC SDR 35 (Storm Drain)

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to furnish and install the 21-inch PVC SDR 35 storm drain. This Bid Item includes, but is not limited to, the procurement and installation of all pipe, fittings, couplings, polyethylene encasement, locating wire, buried piping locator tape, and appurtenances. The Contractor shall perform all activities, including but not limited to; excavation, shoring, subgrade preparation, bedding preparation, laying of pipe, installation of thrust blocks or joint restraints, backfill, compaction and testing of gravity pipelines. The Contractor is responsible for the procurement of backfill material that meets the criteria presented in these specifications and plans. The City will perform compliance testing of the trench backfill. The Contractor is required to coordinate with the City for all compliance testing.
2. **Measurement:** Bid Item will be paid on a per linear foot basis and will be measured per linear foot of pipeline installed.
3. **Payment:** Payment for the Pipe will be made at the linear foot price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete installation of the pipeline as shown and required by these specifications.

BID ITEM 17. 12-inch PVC SDR 35 (Storm Drain)

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to furnish and install the 12 -inch PVC SDR 35 storm drain. This Bid Item includes, but is not limited to, the procurement and installation of all pipe, fittings, couplings, polyethylene encasement, locating wire, buried piping locator tape, and appurtenances. The Contractor shall perform all activities, including but not limited to; excavation, shoring, subgrade preparation, bedding preparation, laying of pipe, installation of thrust blocks or joint restraints, backfill, compaction and testing of gravity pipelines. The Contractor is responsible for the

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procurement of backfill material that meets the criteria presented in these specifications and plans. The City will perform compliance testing of the trench backfill. The Contractor is required to coordinate with the City for all compliance testing.

2. **Measurement:** Bid Item will be paid on a per linear foot basis and will be measured per linear foot of pipeline installed.
3. **Payment:** Payment for the Pipe will be made at the linear foot price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete installation of the pipeline as shown and required by these specifications.

BID ITEM 18. 12-inch Class 50 Ductile Iron Pipe (Storm Drain)

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to furnish and install 12 -inch ductile iron pipe class 50 storm drain. This Bid Item includes, but is not limited to, the procurement and installation of all pipe, fittings, couplings, polyethylene encasement, locating wire, buried piping locator tape, and appurtenances. The Contractor shall perform all activities, including but not limited to; excavation, shoring, subgrade preparation, bedding preparation, laying of pipe, installation of thrust blocks or joint restraints, backfill, compaction and testing of gravity pipelines. The Contractor is responsible for the procurement of backfill material that meets the criteria presented in these specifications and plans. The City will perform compliance testing of the trench backfill. The Contractor is required to coordinate with the City for all compliance testing.
2. **Measurement:** Bid Item will be paid on a per linear foot basis and will be measured per linear foot of pipeline installed.
3. **Payment:** Payment for the Pipe will be made at the linear foot price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete installation of the pipeline as shown and required by these specifications.

BID ITEM 19. Site Grading

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to grade the water storage tank and pump station site and construct the earthen pad which includes, but is not limited to, excavation, scarification of subgrade, imported fill, process native materials, compaction, rough and fine grading, and testing in accordance with the Contract Documents.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

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BID ITEM 20. Swale

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to construct the swale in accordance with Contract Drawing Detail 3, CG-05 and C-101 and specifications.
2. **Measurement:** Bid Item will be paid on a linear foot basis and will be measured per linear foot of swale installed.
3. **Payment:** Payment for Bid Item will be made at the linear foot price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 21. 6-foot Tall Chain Link Fence and Swing Gate

1. **Description:** The Contractor shall furnish and install new 6-foot tall fencing (chain-link and wire type) with three (3) strands of barbed wire as shown in accordance with the Drawings and Specifications. Work includes installation of man gate as shown on drawings.
2. **Measurement:** Bid Item will be paid on a linear foot basis and measured per linear foot of fence installed.
3. **Payment:** Payment for Bid Item will be made at the linear foot price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 22. 16-foot Wide Drive Gate

1. **Description:** The Contractor shall install 16-foot wide drive gates and furnish and install all other required items to complete the gate assembly with concrete strip in accordance with the Drawings and Specifications.
2. **Measurement:** Bid Item will be paid on a per unit price basis and will be measured per individual 16-foot wide drive gate installed.
3. **Payment:** Payment for the 16-foot wide drive gate Bid Item will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the installation of the 16-foot wide drive gates as shown and required by these specifications.

BID ITEM 23. ¾-Inch Rock Ground Cover at Tank Site

1. **Description:** The Contractor shall furnish and place gravel rock at the project site, including fine grading, compaction, testing, inspection, and subgrade preparation, in accordance with the Drawings and Specifications.
2. **Measurement:** Bid Item will be paid on a square foot basis and will be measured per square foot of rock ground cover installed.
3. **Payment:** Payment for Bid Item will be made at the square foot price bid in the Proposal, which shall include full compensation for furnishing all materials, labor,

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tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 24. Drive Approach

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to construct reinforced commercial driveway per the contract drawings C-101 and CG-05, Detail 1, including, but not limited to, concrete, forms, reinforcement, overexcavation, shoring, subgrade preparation, placement of engineered fill, compaction, testing, and inspection in accordance with the Drawings and Specifications. Additional items included sawcut removal and replacement up to 2 feet beyond the drive approach existing HMA pavement for installation and connection of Drive approach to existing road as required by the Owner.
2. **Measurement:** Bid Item will be paid on a square foot basis and will be measured per square foot of concrete installed.
3. **Payment:** Payment for Bid Item will be made at the square foot price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 25. Furnish and Install Building Plumbing and Drainage

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to Furnish and Install building plumbing including, but not limited to, plumbing of the facilities, drain, 4-inch PVC pipe, all necessary appurtenances, and other incidentals to complete the Work not part of any other bid item.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 26. Bollards

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to construct 6" bollards in accordance with Contract drawing CG-05 and specifications and where indicated on the Contract drawings.
2. **Measurement:** Bid Item will be paid on a per unit price basis and will be measured per individual bollard installed.
3. **Payment:** Payment for the bollard Bid Item will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete installation of the bollard as shown and required by these specifications.

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BID ITEM 27. 5-foot Concrete Sidewalk

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to construct concrete sidewalk around the pump building, including, but not limited to, overexcavation, shoring, subgrade preparation, placement of engineered fill, compaction, testing, and inspection in accordance with the Drawings and Specifications.
2. **Measurement:** Bid Item will be paid on a linear foot basis and will be measured per square foot of concrete sidewalk installed.
3. **Payment:** Payment for Bid Item will be made at the linear foot price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 28. Booster Pump Pedestal

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to construct reinforced concrete booster pump foundations, including, but not limited to, overexcavation, shoring, subgrade preparation, placement of engineered fill placement, compaction, testing, and inspection in accordance with the Drawings and Specifications.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 29. Pump Building Foundation

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to construct reinforced concrete pump building foundations, including, but not limited to, overexcavation, shoring, subgrade preparation, placement of engineered fill, compaction, testing, and inspection in accordance with the Drawings and Specifications.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 30. Electrical Prefabricated Building

1. **Description:** The Prefabricated Building is a design build bid item. The Contractor shall include design and plans by the manufacturer for the prefabricated building. This item shall include providing all labor, materials, building permits, transportation, supplies, tools, equipment, and incidentals required to Furnish and install the prefabricated building over the electrical

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room per contract drawing M-01, C-101, and the specifications, including, but not limited to structural steel, beams, anchor bolts, gutters, frames, roof panels, coatings, fabrication, ventilation, insulation, concrete curb (installed for both the electrical prefabricated building and the pump room building extension), and other incidentals to complete the Work.

2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 31. Mechanical Room 18-inch Adjustable Pipe Supports

1. **Description:** This item shall include providing all labor, materials, building permits, transportation, supplies, tools, equipment, and incidentals required to Furnish and install the 18-inch adjustable pipe supports as shown on the Drawings
2. **Measurement:** Bid Item will be paid on a unit price basis and will be measured per individual pipe support installed.
3. **Payment:** Payment for the Bid Item will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete installation of the pipe support as shown and required by these specifications.

BID ITEM 32. Mechanical Room 8-inch Adjustable Pipe Supports

1. **Description:** This item shall include providing all labor, materials, building permits, transportation, supplies, tools, equipment, and incidentals required to Furnish and install the 8-inch adjustable pipe supports as shown on the Drawings
2. **Measurement:** Bid Item will be paid on a unit price basis and will be measured per individual pipe support installed.
3. **Payment:** Payment for the Bid Item will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete installation of the pipe support as shown and required by these specifications.

BID ITEM 33. Mechanical Room Concrete Pad Pipe Supports

1. **Description:** This item shall include providing all labor, materials, building permits, transportation, supplies, tools, equipment, and incidentals required to Furnish and install the concrete pad pipe supports as shown on the Drawings.
2. **Measurement:** Bid Item will be paid on a unit price basis and will be measured per individual pipe support installed.

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3. **Payment:** Payment for the Bid Item will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete installation of the pipe support as shown and required by these specifications.

BID ITEM 34. Generator Pad Foundation

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to construct reinforced concrete generator pad foundations for the outdoor electrical equipment (meter/main, ATS, Power, etc) and generator, including, but not limited to, overexcavation, shoring, subgrade preparation, placement of engineered fill, compaction, testing, and inspection in accordance with the Drawings and Specifications.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 35. Water Tank Foundation

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to construct reinforced concrete ringwall and center column foundations, including, but not limited to, overexcavation, shoring, subgrade preparation, placement of engineered fill, compaction, testing, and inspection in accordance with the Drawings and Specifications.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 36. Meter/Main, ATS, Power Distribution

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to furnish and install the Meter/Main and Power Distribution Switchboard complete and in place as shown on the Plans. This shall include, but not be limited to, installation of new switchboard, bus splices, and associated power and control wires, conduit, junction boxes, grounding, all associated hardware, testing, and other incidentals to complete the Work.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor,

tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 37. Site Electrical Materials

1. **Description:** The Contractor shall furnish and install site electrical which includes, but is not limited to, the labor and materials for installation of all electrical equipment which is not included in another bid item, which includes lighting control panel, site lighting conduits, cables, junction/pull boxes, antenna mast, concrete pads, pedestals/stanchions, site area lights, struts, mounting hardware, trenching, shoring, startup and testing, inspection, and shipping in accordance with the Drawings and Specifications.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 38. Variable Frequency Drive

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to furnish and install the variable frequency drive complete and in place as shown on the Plans. This shall include, but not be limited to, installation of new variable frequency drive, and associated power and control wires, conduit, junction boxes, grounding, all associated hardware, testing, and other incidentals to complete the Work.
2. **Measurement and Payment:** The Final Pay Quantity Unit Price per variable frequency drive paid for this item shall include full compensation for all labor, materials, transportation, supplies, tools, equipment, and incidentals and for doing all other work and operations which must be performed or costs incurred prior to beginning, during and after the completion of the Work on this contract item and no additional allowance shall be made therefore.

BID ITEM 39. PLC Panel

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to furnish and install the PLC Panel complete and in place as shown on the Plans. This shall include, but not be limited to, installation of new PLC Panel, and associated power and control wires, conduit, junction boxes, grounding, all associated hardware, testing, and other incidentals to complete the Work.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 40. Utility Costs

1. **Description:** The Contractor shall furnish and install utility substructures (primary and secondary – no cables), utility transformer pad, grounding system, and utility transformer, which includes, but is not limited to, excavation, shoring, backfill, compaction, concrete foundations, testing, and inspection in accordance with the Drawings and Specifications.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 41. PLC and SCADA Programming

1. **Description:** This item shall include providing all labor, programming, configuration, tools, equipment, and incidentals required to furnish, install and test the PLC and SCADA Programming, including, all associated communications equipment, software and hardware, and other incidentals to complete the Work. Bid item shall also include training with City Staff.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 42. Instrumentation

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to furnish and install instrumentation complete and in place as shown on the Plans. This shall include, but not be limited to, installation of the Instrumentation (ie. magnetic flowmeter, pressure gauges, etc.), and associated power and control wires, conduit, junction boxes, grounding, process connection equipment, all associated mounting hardware, testing, and other incidentals to complete the Work.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 43. 1,000 GPM Booster Pump

1. **Description:** The Contractor shall furnish and install horizontal axial split case pumps, baseplates, motors, air valves and piping, including shop and field coating/painting, in accordance with the Drawings and Specifications.

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2. **Measurement:** Bid Item will be paid on a per unit price basis and will be measured per individual 1,000 GPM booster pump.
3. **Payment:** Payment for the bid item will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete installation of the bid item as shown and required by these specifications.

BID ITEM 44. Pump Station Start up and Testing.

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to test and commission each pump station in conformance with the Contract Documents. Work for each station generally includes the following: (a) Certification from the pump manufacturer that each new pump has been correctly installed by the Contractor and that all warranties are in effect prior to operation; (b) Start-up and commissioning services to confirm correct operation of the new pumps; (c) Submission of installation instructions, operation and maintenance manuals; and (d) Training session with the Owner's operators.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 45. Ductile Iron Fittings and Appurtenances for the Booster Pump Station (BPS)

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to Furnish and Install ductile iron fittings of all sizes as indicated on the Booster Pump piping plan and required per the contract drawing M-01 and P-02 including, but not limited to, tees, elbows, reducers, blind flange, cast collars, adaptors, restrained fittings, and other incidentals to complete the Work. Any items indicated on the Booster Pump piping plan, or booster pump flow diagram not included on any other bid item shall be covered under this bid item.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 46. Ductile Iron Pipe Spools (BPS)

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to Furnish and Install all ductile iron pipe spools of varying sizes (4-inch, 6-inch, 8-inch, 12-inch, and 18-inch) per the contract drawing M-01 and P-02 including, but not limited to, adaptors, taps, restrained fittings, and other incidentals to complete the Work.

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2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 47. 8-inch Check Valve (BPS)

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to Furnish and Install 8" Check Valve per the contract drawing M-01 and P-02 including, but not limited to, adaptors, restrained fittings, all necessary appurtenances, and other incidentals to complete the Work.
2. **Measurement:** Bid Item will be paid on a per unit price basis and will be measured per individual 8-inch Check Valve installed.
3. **Payment:** Payment for the bid item will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete installation of the bid item as shown and required by these specifications.

BID ITEM 48. 18-Inch Flanged Gate Valve Assembly (BPS)

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to Furnish and Install 18-inch Flanged Gate Valve Assembly, but not limited to, adaptors, restrained fittings, all necessary appurtenances, and other incidentals to complete the Work.
2. **Measurement:** Bid Item will be paid on a per unit price basis and will be measured per individual 18-inch Gate Valve Assembly installed.
3. **Payment:** Payment for the bid item will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete installation of the bid item as shown and required by these specifications.

BID ITEM 49. 12-Inch Flanged Gate Valve Assembly (BPS)

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to Furnish and Install 12-inch Flanged Gate Valve Assembly, but not limited to, adaptors, restrained fittings, all necessary appurtenances, and other incidentals to complete the Work.
2. **Measurement:** Bid Item will be paid on a per unit price basis and will be measured per individual 12-inch Gate Valve Assembly installed.
3. **Payment:** Payment for the bid item will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to

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complete installation of the bid item as shown and required by these specifications.

BID ITEM 50. 8-Inch Flanged Gate Valve Assembly (BPS)

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to Furnish and Install 8-inch Flanged Gate Valve Assembly, but not limited to, adaptors, restrained fittings, all necessary appurtenances, and other incidentals to complete the Work.
2. **Measurement:** Bid Item will be paid on a per unit price basis and will be measured per individual 8-inch Gate Valve Assembly installed.
3. **Payment:** Payment for the bid item will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete installation of the bid item as shown and required by these specifications.

BID ITEM 51. Flow Control Valve Assembly (BPS)

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to furnish and install flow control valve including, but not limited to, adaptors, restrained fittings, associate power and control wire, testing, all necessary appurtenances, and other incidentals to complete the Work.
2. **Measurement:** Bid Item will be paid on a per unit price basis and will be measured per individual Flow Control Valve Assembly installed.
3. **Payment:** Payment for the bid item will be made at the unit price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete installation of the bid item as shown and required by these specifications.

BID ITEM 52. Chlorination System and Appurtenances

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to furnish and install the chlorination system and appurtenances complete and in place as shown on the Plans. This shall include, but not be limited to, installation of chlorine analyzer, emergency eye-wash station, tap, chlorine metering pump, 40 gallon vertical storage tank mounted inside weather resistant plastic storage shed, and other incidentals to complete the Work.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 53. Water Storage Tank

1. **Description:** The Water Storage Tank is a design build bid item. The Contractor shall include design and preparation of plans by the manufacturer for the tank. The Contractor shall provide all materials, equipment, labor, and incidentals to furnish and install the water storage tank per the contract drawings and specifications. Bid Item includes, but is not limited to, the procurement and installation of all material to construct the water storage tank, center column, ring shell, floor plate, roof plate, rafters, welding, testing, and other incidentals necessary to complete the water storage tank as shown.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 54. Water Storage Tank – Interior Coating

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to furnish and install the water storage tank interior coating per the contract drawings and specifications. Bid Item includes, but is not limited to, the procurement and installation of all material to construct the water storage tank interior coating.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 55. Water Storage Tank – Exterior Coating

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to furnish and install the water storage tank exterior coating per the contract drawings and specifications. Bid Item includes, but is not limited to, the procurement and installation of all material to construct the water storage tank exterior coating.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 56. Water Storage Tank – Appurtenances and Cathodic Protection

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to design, furnish and install all water tank appurtenances that are not

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covered by the bid item titled "water storage tank furnish and install", including, but not limited to cathodic protection, roof access hatch and ladder, access manway, level transmitter, water level indicator, railing, bumped head cap, and all necessary appurtenances.

2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 57. Water Tank 12-inch Inlet Line and Appurtenances

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to Furnish and Install Water Tank inlet per Contract Drawing CG-02, Detail 2 and C-101 including, but not limited to, coupling adapters, valves, spools, welded steel pipe, fittings, coating and lining, restraints, supports, bedding and backfilling, imported trench backfill, concrete encasement, compaction, dewatering, pressure test joints, and all necessary appurtenances.

Includes furnishing and installing the following items:

- a. The entirety of 12-inch welded steel pipe, fittings, and appurtenances shown on CG-02, Detail 2 including the buried steel pipe from the flexible expansion joint to the submerged steel piping located inside the tank.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
 3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 58. Water Tank 18-inch Outlet Line and Appurtenances

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to Furnish and Install Water Tank inlet per Contract Drawing CG-02, Detail 2 and C-101 including, but not limited to, coupling adapters, valves, spools, welded steel pipe, fittings, coating and lining, restraints, supports, bedding and backfilling, imported trench backfill, concrete encasement, compaction, dewatering, pressure test joints, and all necessary appurtenances.

Includes furnishing and installing the following items:

- a. The entirety of 18-inch welded steel pipe, fittings, and appurtenances shown on CG-02, Detail 2 including the buried steel pipe from the flexible expansion joint to the submerged steel piping located inside the tank.

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2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 59. Water Tank Overflow Line

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to Furnish and Install Water Tank 18-inch overflow pipe and weir per Contract Drawing CG-02, Detail 1 and P-02 including, but not limited to, coupling adapters, valves, spools, welded pipe, fittings, restraints, supports, hangers, bolts, nuts, washers, welding and all necessary appurtenances. This bid item does not include the concrete vault, or below grade piping shown.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 60. Water Tank Drain Line and Valve

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to Furnish and Install Water Tank 8-inch Drain Line per Contract Drawing CG-02, Detail 4 including, but not limited to, 8-inch gate valve with handwheel, welded pipe, coating and lining, flange to camlock adapter, bolts, nuts, washers, welding and all necessary appurtenances.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

1.03 ADDITIONAL BID 1 - PREFABRICATED BUILDING

Selection of Additional Bid 1 shall include the additional cost to extend Bid Item 30 Electrical Prefabricated Building over the pump/mechanical room.

BID ITEM 61. Prefabricated Building Extension

1. **Description:** The Prefabricated Building is a design build bid item. The Contractor shall include design and preparation of plans by the manufacturer for the prefabricated building as a whole singular structure. This item shall include all the items that are in addition to that of Bid Item 30. This item shall include

providing all labor, materials, building permits, transportation, supplies, tools, equipment, electrical, lighting, additional conduit, and incidentals required to Furnish and install the prefabricated building extension over the pump room per contract drawing M-01, C-101, and specifications, including, but not limited to structural steel, beams, anchor bolts, gutters, frames, roof panels, coatings, fabrication, ventilation, insulation, pipe hangers, and other incidentals to complete the Work.

2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

1.04 ADDITIONAL BID 2 – EMERGENCY GENERATOR

BID ITEM 62. Emergency Generator

1. **Description:** This item shall include providing all labor, materials, transportation, supplies, tools, equipment, and incidentals required to furnish and install the emergency generator complete and in place as shown on the Plans. This shall include, but not be limited to, installation of new generator, bus splices, and associated power and control wires, conduit, junction boxes, grounding, all associated hardware, testing, and other incidentals to complete the Work.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor, tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

BID ITEM 63. Gas Connection Complete

1. **Description:** The Contractor shall provide all materials, equipment, labor, and incidentals to tie in and connect the gas line for one generator and stub out the gas line for the future generator, including, but not limited to, pavement removal and replacement, procurement and installation of gas line and all fittings and requirements of PG&E, locating wire, locator tape, pavement removal and replacement, excavation, shoring, subgrade preparation, bedding preparation, backfill, compaction, and testing. The Contractor is responsible for the procurement of backfill and installation in accordance with PG&E requirements. The Contractor is required to coordinate all work with the City and PG&E for compliance.
2. **Measurement:** Bid Item will be paid on a lump sum basis and no measurement of quantities will be made.
3. **Payment:** Payment for Bid Item will be made at the lump sum price bid in the Proposal, which shall include full compensation for furnishing all materials, labor,

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tools, equipment, and incidentals and for doing all the work necessary to complete the Bid Item as shown and required by the specifications.

PART 2 MATERIALS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED

PART 1 GENERAL

1.01 SUBMITTAL REQUIREMENTS

A. Description:

1. This section covers the submittal requirements. The Contractor shall provide submittals as described in this section. The types of submittals are listed in the Submittal Register in Paragraph 3.01.
2. Supplementary General Conditions, General Conditions, other sections, and Drawings apply to this section.

B. General:

1. Submittals shall be furnished as specified herein and in accordance with General Conditions, Special Conditions, and SSPWC Subsection 3-8.
2. Neither the review nor lack of review of submittals shall waive the requirements of the Contract or relieve the Contractor of any obligations thereunder.
3. The Contractor shall check, correct, and sign submittals prior to submission, whether they are prepared by the Contractor or others.

C. Identification of Submittals:

1. Submittals, including each drawing, shall be plainly identified by a file number, the Contractor's name, Contract number, Project name and location, Specification number, and description and location of applicable portions of the Project. Submittals shall be in English language and units shall be in the English system of units, as used in the United States.
2. The features shall be referenced to the Specification number, bid item numbers and Contract drawing number.
3. Resubmittals shall also include the file number, modified to distinguish revision number.

D. Time of Submission:

1. The Contractor shall furnish submittals as specified and in such manner and sequence that they may be inspected in an orderly manner prior to performance of the Work.
2. The Contractor shall submit all related information necessary for such inspection.

E. Method of Transmittal:

1. Submittals shall be sent to the Engineer electronically by uploading to an approved location.
2. The Engineer will return submittals to the designated location and will notify the Contractor by e-mail when the returned submittal is uploaded.

F. Definition of Received and Returned:

1. Submittals and resubmittals will be considered received by the Engineer on the date the Engineer receives an e-mail notification that the submittal has been uploaded to the

designated location, provided the submittal has been properly uploaded as determined by the Engineer. If the e-mail is sent after 15:30 California local time or on a weekend or State holiday, the official date received will be the next business day.

2. Submittals will be considered returned to the Contractor on the date the Engineer sends the Contractor an e-mail that the returned submittal has been uploaded to the designated location, provided the submittal has been properly uploaded.
3. Submittals will be considered received by the Contractor on the date the Engineer sends an e-mail notification that the submittal has been uploaded to the Department's electronic server location, provided the submittal has been properly uploaded.

1.02 INJURY AND ILLNESS PREVENTION PROGRAM

A. Injury and Illness Prevention Program: Pursuant to General Conditions and Special Conditions:

1. The Contractor shall prepare, submit to the Engineer, and disseminate among those performing work at the Work site a written Cal/OSHA-compliant program for injury and illness prevention.
2. Within the specified period and periodically thereafter, the Contractor shall meet with the Engineer to review safety practices at the Work site for Cal/OSHA compliance. Promptly after each meeting, any revisions of the safety program and/or practices shall be enacted, with written changes prepared, submitted and disseminated.

B. Pre-Work Safety Plan:

1. The Contractor shall prepare and submit a Pre-Work Safety Plan (PWSP) that shall include the sequence of events (scope of work), identification of potential risks and/or hazards, discussion of mitigation or risk reduction methods, and list of actionable measures (action items).

C. Accident Reports:

1. The Contractor shall submit to the Engineer reports of injury and illness incidental to work at the Work site which result in death, injury, damage to property, or cases of occupational disease.
2. Reports will be considered confidential to the extent permitted by law and will be used solely to develop information for use in prevention of future injury and illness.

D. Summary Report:

E. Falsework and Formwork:

1. Pursuant to the General Conditions and Special Conditions, the Contractor shall comply with Section 1717 of the Safety Orders.
2. At least 30 days prior to their use, the Contractor shall furnish to the Engineer any falsework or vertical shoring system and certification of such system required by Safety Orders.

1.03 WORKING DRAWINGS AND DATA

A. General:

1. Each submittal of working drawings and data in the form of reproducible prints and optional electronic media shall be accompanied by a letter containing a list of titles and numbers of the Drawings and data submitted as specified in Paragraph 1.01 C, Identification of Submittals. A title shall be included on each working drawing and data sheet identifying the feature or features shown on the working drawing or data sheet.
 2. Working Drawings:
 - a. General: Working drawings shall conform to ANSI Standard Y14.1, Engineering Drawing Sheet Size D (22 inch by 34 inch), or larger unless otherwise approved. Working drawings may include, without limitation, equipment assembly drawings, shop drawings, electrical schematics, wiring diagrams, pipe layouts and similar working drawings. The working drawings shall contain required plan views, cross sections, details, and other information necessary for the Work. Working drawings of structures, reinforcing steel, pipeline layouts and details shall be drawn to scale.
 3. Data:
 - a. Data on materials and equipment may include, without limitation, materials and equipment lists, parts list, instruction sheets, catalog data sheets, performance curves, diagrams, samples, and similar descriptive material. Data on materials and equipment shall contain the name and location of the supplier or manufacturer, telephone number, trade name, catalog reference, model number and all other pertinent data.
 4. The Contractor shall submit:
 - a. Samples in triplicate.
 - b. One copy of each Computer-Aided Drafting (CAD) drawing file on separate electronic file:
 - 1) The files shall be labeled with the Specification number, Contract number, Project name, and location as specified in Paragraph 1.01 C, Identification of Submittals.
 - 2) The CAD drawing files and other data shall be submitted in Adobe PDF format and AutoCAD format with a 300 dots per inch minimum resolution. Each file shall contain only one drawing. Other formats of the files will be considered acceptable provided the Engineer has the proper software to read the files.
 - 3) The following information shall be submitted with the electronic files:
 - 4) Name of software used to create the Drawings and files.
 - 5) An index correlating drawing titles and filenames for each electronic submittal package.
- B. Inspection and Revision:

1. The Engineer will inspect and return working drawings and data within 15 days after receipt thereof, or within 15 days after receipt of all related information necessary for such inspection, whichever is later. After review, electronic copies of each working drawing and two copies of data will be returned, marked “NO EXCEPTIONS TAKEN”, “MAKE CORRECTION NOTED”, “REVISE AND RESUBMIT”, or “REJECTED”. Defects discovered on inspection will be indicated on the working drawing or data, or otherwise communicated to the Contractor in writing.
2. Samples to be incorporated in the Project will be returned, together with a written notice designating the sample:
 - a. NO EXCEPTIONS TAKEN.”
 - b. “MAKE CORRECTION NOTED.”
 - c. “REVISE AND RESUBMIT.”
 - d. “REJECTED” and indicating defects discovered on inspection.
 - e. “NO ACTION TAKEN” for information only.
 - f. Other samples not going to be incorporated in the Project will not be returned, but the same notice will be given with respect thereto, and such notice shall be considered a return of the sample.
3. A working drawing or data designated “REVISE AND RESUBMIT” or “REJECTED” shall be revised or corrected and resubmitted in its entirety to the Engineer within 10 days after its receipt by the Contractor, unless revision or correction is waived by the Engineer. Resubmittal of just the corrections and not the entire submittal will not be accepted unless directed.
 - a. Such resubmittals will be reinspected and returned in the same manner as original Drawings and data within 15 days after receipt thereof, or within 15 days after receipt of all related information necessary for such reinspection, whichever is later.
 - b. Any revised drawing or data designated “REVISE AND RESUBMIT” or “REJECTED” and any corrected sample so designated shall be further reinspected or corrected in accordance with the foregoing procedures.
4. The Contractor may proceed with any work covered by a working drawing or data designated “NO EXCEPTIONS TAKEN” or “MAKE CORRECTION NOTED” provided the Contractor complies with the comments noted. The Contractor may also proceed with the unaffected portions of the Work covered by a working drawing or data designated “MAKE CORRECTION NOTED”; and, if resubmittal is expressly waived in writing, may proceed with any Work covered by such working drawing or data, provided that the Contractor proceeds in accordance with the Engineer’s notes and comments.
5. The Contractor shall not begin any Work covered by a working drawing or data designated “REJECTED,” or any portion of Work noted as defective on a working

drawing or data designated "MAKE CORRECTION NOTED" if resubmittal is not expressly waived in writing.

C. Submittal Schedule:

1. The Contractor shall submit to the Engineer a Submittal Schedule and Submittal Register for submission of working drawings and data. Such schedule shall list working drawings and data and the number of days after the receipt of notice to begin Work that working drawings and data shall be submitted.
2. Working drawings and data shall be in such manner and sequence that they may be inspected in an orderly manner before the subject portions of the Work are performed.
3. The Submittal Schedule will be inspected by the Engineer and the Contractor shall correct any defects noted.
 - a. The Submittal Schedule shall present a complete and current plan for orderly submission of such Drawings and data.
 - b. The Contractor shall promptly notify the Engineer of any occurrence requiring substantial revision of the Submittal Schedule and shall furnish a revised schedule within 15 days of such occurrence.
 - c. Revised schedules will be inspected and corrected in the same manner as the original schedule.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 SUBMITTAL REGISTER

- A. The Contractor shall coordinate the Submittal Register with the requirements of the Specification, and the listing of the submittals in the Submittal Register below shall not relieve the Contractor from providing additional submittals specified.

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SPEC PARA NO.	DESCRIPTION OF SUBMITTAL	TYPE OF SUBMITTAL							REMARKS
		WORKING DWGS	PLAN	SAMPLE	PRODUCT DATA	CERT.	TEST	OTHERS AS SPECIFIED	
1.02	01330-Submittals							X	<ul style="list-style-type: none"> •Injury and Illness Prevention Program. •Pre-Work Safety Plan •Accident Reports •Summary Report •Falsework and Formwork
1.03.C	01330-Submittals							X	Submittal Schedule and Submittal Register
1.02	01380-Preconstruction Audio Video Recording							X	•Initial Audio, Video Recording and Photographs
1.02	01380-Preconstruction Audio Video Recording							X	•Final Audio, Video Recording and Photographs
1.02	01551-Traffic Control		X					X	
1.04	01570-Environmental Protection	X	X						
1.02	01580-Signage			X	X				
1.04	01650-Start Up and Commissioning	X	X	X	X			X	
1.03	01720-As Built Project Documents and Surveys							X	•Draft As-Built Drawing and Specifications to be submitted monthly or as requested by Engineer.
1.03	01720-As Built Project Documents and Surveys							X	•Final As-Built Drawing and Specification
1.03	01720-As Built Project Documents and Surveys							X	•Draft O&M
1.03	01720-As Built Project Documents and Surveys							X	•Final O&M
1.04	02100-Clearing, Grubbing, and Demolition		X					X	•Demolition Permit Release and Asbestos Notification
1.05.B	02210- Geotechnical Investigation		X						
1.03	02223-Excavation, Backfill and Compaction	X	X		X			X	<ul style="list-style-type: none"> •Equipment and Methods •Sampling and Testing •72 Hour Minimum Inspection Request
1.02.B	02512-Water Pipe and Fittings	X			X	X	X	X	<ul style="list-style-type: none"> •Steel Pipe •Welding Requirements
1.02.C	02512-Water Pipe and Fittings	X			X	X		X	•Ductile Iron and PVC Pipe
1.02.D	02512-Water Pipe and Fittings				X	X		X	•Galvanized Steel Pipe
1.02.E	02512-Water Pipe and Fittings				X	X		X	•Copper Pipe
1.02.F	02512-Water Pipe and Fittings				X	X		X	•Polyethylene Pipe
1.02.G	02512-Water Pipe and Fittings	X			X	X		X	•Couplings
1.02.H	02512-Water Pipe and Fittings				X			X	•Material Other

01330 - SUBMITTALS

SPEC PARA NO.	DESCRIPTION OF SUBMITTAL	TYPE OF SUBMITTAL							REMARKS
		WORKING DWGS	PLAN	SAMPLE	PRODUCT DATA	CERT.	TEST	OTHERS AS SPECIFIED	
1.02.I	02512-Water Pipe and Fittings	X	X					X	•Connections
1.02.J	02512-Water Pipe and Fittings		X						•Hydrostatic Testing
1.03	02624-Exploratory Excavations		X				X	X	•Contractor shall submit Deviations from Drawings within 24 hours.
1.02	02633-Storm Drain and Fittings				X	X	X		
1.03	02635-Drainage Structures	x			x	x		x	
1.02	02720-Aggregate Base				X	x	X	X	
1.02	02741-Asphalt Concrete Pavement		X		X	X	X	X	
1.03	02820-Fencing and Appurtenances	X			X	X		X	
1.03	03300-Concrete Works	X	X		X	X	X	X	
1.02	03310-Concrete Curbs, Gutters, and Sidewalks		X			X	X	X	•Provide 72 Hour minimum notice for Inspection Request.
1.03	05120-Structural Steel and Miscellaneous metal works	X	X		X	X	X	X	
1.03	07900-Sealants and Caulking				X	X	X	X	
1.03	09900-Protectvite Coating			X	X	X	X	X	
1.03	09902-Steel Tank Interior and Exterior Coating				X	X			
1.04	11240-Chemical Feed System	X			X			X	
1.03	13150-Tank Cathodic Protection	X	X		X		X	X	
1.03	13208-Welded Steel Tank	X	X		X	X	X	X	•Provide Daily Welding Inspection Report
1.05	15006-Pipe Supports	X				X		X	
1.02	15012-Ductile Iron Piping	X			X	X		X	
1.02	15030-Valves and Appurtenances	X			X	X		X	
1.04	15041-Disinfection of Water Mains, Pump Stations, and Reservoirs	X	X			X	X	X	
1.02	15119-Hydraulically Actuated Valve	X	X		X	X		X	
1.02	15112-Meters and Gauges	X			X	X	X	X	
1.02	15151-Facility Identification	X		X	X	X	X	X	•Provide 72 Hour minimum notice for Testing.
1.09	16010-Electrical General				X		X	X	
1.04	16110-Conduit and Boxes	X			X		X	X	
1.04	16120-Low Voltage Wire & Data Cable	X			X		X	X	
1.04	16210-Engine Generator	X			X	X	X	X	

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SPEC PARA NO.	DESCRIPTION OF SUBMITTAL	TYPE OF SUBMITTAL							REMARKS
		WORKING DWGS	PLAN	SAMPLE	PRODUCT DATA	CERT.	TEST	OTHERS AS SPECIFIED	
1.03	16250-Automatic Transfer Switch				X	X	X	X	
1.04	16450-Grounding				X	X	X	X	
1.02	16470-Panelboard and Power Transformer	X			X	X	X	X	
1.03	16481-Variable Frequency Drive	X			X	X	X	X	
1.05	16600-Factory and Field Testing				X	X	X	X	
1.02	16630-Electrical System Analysis	X			X	X	X	X	
1.03	16905-Control Panels	X			X	X	X	X	
1.03	16910-PLC & OI Hardware	X			X	X	X	X	
1.03	16940-Instrumentation				X	X	X	X	

PART 1 GENERAL

1.01 SCOPE

- A. This section describes the requirements for pre-construction audio video recording of roadways and above grade facilities along the proposed pipeline alignments and at the tank site.
- B. Furnish all labor, materials, and equipment to furnish color audio video recording of the Project site as specified herein.
- C. The Contractor shall take construction progress photographs, as needed and as specified.
- D. The Owner reserves the right to reject the audio video recording because of poor quality, unintelligible audio, or uncontrolled pan or zoom. Any audio video recording rejected by the Owner shall be redone at no cost to the Owner. Under no circumstances shall construction begin until the Owner has received and accepted the audio video(s).

1.02 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled **“Submittals.”**
- B. Audio video recording firm qualifications and references.
- C. Initial and final audio, video recording, and photographs.

1.03 QUALITY ASSURANCE

- A. The recording shall be performed by a qualified, established audio video recording firm knowledgeable in construction practices which has a minimum of one (1) year of experience in the implementation of established inspection procedures.
- B. The audio video recording firm shall submit three (3) letters of recommendation from municipalities, and/or engineering firms indicating previous experience and ability to perform the Work described in this Contract. Data substantiating qualifications must be submitted and accepted prior to performing the survey.

PART 2 MATERIALS

2.01 VIDEO RECORDING EQUIPMENT

- A. The Contractor’s video recording capability, equipment, and operators shall conform to the following minimum criteria:
 - 1. High resolution and clarity shall be provided by a process such as utilizing HD digital video recording equipment and converting to Blu-ray (720p or 1080p) format.
 - 2. The video recording shall be automatically dated and timed.
 - 3. The video camera shall be equipped with a zoom lens.
 - 4. The system shall have cataloging and storage capacity.

2.02 DIGITAL PHOTO EQUIPMENT

- A. The Contractor shall provide a new HD digital camera of at least 20.0 effective megapixel resolution for this Project. The camera shall be manufactured by a firm with a reputable name in the camera business (Nikon; Sony; Olympus; Canon; Minolta; Ricoh; Kodak; or equal).
- B. The camera shall utilize a universal platform memory card or “flash” card for storing digital photographs.
- C. The camera shall utilize an automatic focus, F-stop, and built-in flash system with manual override to promote quality photography.
- D. The Contractor shall provide a minimum of two flash cards, each having a minimum capacity of 64 gigabytes (GB). In the event that a flash card is filled to capacity, the Contractor shall transfer the photographic files to multiple DVD-RW discs, as needed, and present the discs to the Owner.
 - 1. If the digital camera or any flash cards are destroyed or damaged beyond use during the course of the Project, the Contractor shall replace the items at no additional cost to the Owner.

PART 3 EXECUTION

3.01 COLOR AUDIO VIDEO SURVEY

- A. Utilizing a compatible format (i.e.: MP4), upload into the Owner’s construction management software, or to a location designated by the Owner, a continuous color audio video recording along the entire route of the proposed pipeline(s) and the entire area for above ground facilities. The recording shall be taken prior to any construction activity and shall include, but are not limited to:
 - 1. Property lines.
 - 2. Right-of-way and easement conditions.
 - 3. Utility markings.
 - 4. Survey conditions.
 - 5. Pavement conditions.
 - 6. Adjacent property conditions.
 - 7. Sidewalk, median, curb, and gutter conditions.
 - 8. Landscaping, planting, and irrigation conditions.
 - 9. Safety conditions.
 - 10. Other unusual conditions or equipment/facility installations.
- B. Pipelines and Roads: Complete coverage shall include all surface features located within the public right-of-way, easement areas, and adjacent private properties covering the extent of the R/W to be utilized by the Contractor of each side of the pipeline centerline and will be supported by appropriate audio description made simultaneously with video coverage. Such coverage shall include, but not be limited to, all existing driveways, sidewalks, curbs, gutters, ditches, channels, bridges, roadways including viaducts, landscaping, trees, culverts, headwalls, and retaining walls, and buildings located within the R/W strip. Video coverage shall extend to the maximum height of all structures within this zone.

- C. Above Ground Facilities: Complete coverage shall include all surface features within 50 feet of the Work area to be utilized by the Contractor and shall be supported by appropriate audio description made simultaneously with video coverage. Such coverage shall include, but not be limited to, all existing driveways, sidewalks, curbs, gutters, ditches, channels, bridges, roadways, landscaping, trees, culverts, headwalls, retaining walls, equipment, structures, pavements, manholes, vaults, handrails, etc. located within the aforementioned Work zone. Video coverage shall extend to the maximum height of all structures within this zone.
- D. All recordings shall be performed during times of good visibility. Recordings shall not be performed during periods of visible precipitation, or when more than ten percent of the ground area is covered with standing water, unless otherwise authorized by the Owner.

3.02 AUDIO AND VIDEO

- A. The Contractor shall upload continuous color, audio-video(s) of professional quality.
- B. Each audio-video shall begin with the Owner's name, the Contract name and number, and the Contractor's name, date, and location information such as street name, direction of travel, viewing side, etc.
- C. Information appearing on the audio-video must be continuous and run simultaneously by computer generated transparent digital information. No editing or overlaying of information at a later date will be acceptable.
- D. Digital information will be as follows:
 - 1. Upper left corner
 - a. Name of Contractor.
 - b. Day, date, and time.
 - c. Name of Project and Specification Number.
 - 2. Lower left corner
 - a. Route of travel.
 - b. Viewing side.
 - c. Direction of travel.
 - d. Pipelines: Stationing.
- E. Time must be accurate and continuously generated.
- F. Engineering station numbers must be continuous, be accurate, and correspond with project stationing. The symbols shall be the standard engineering symbols (i.e. Station 100+00).
- G. Written documentation must coincide with the information on the audio-video so as to make easy retrieval of locations sought for at a later date.
- H. The video system shall have the capability to transfer individual frames of video electronically into hard copy prints.
- I. Audio shall be recorded at the same time as the video recording and shall have the same information as on the viewing screen. Special commentary will be given for unusual conditions of

roads, bridges, ditches, channels, buildings, sidewalks and curbing, foundations, trees and shrubbery, etc.

- J. All audio-video shall have labels with the following information:
1. Recording Number.
 2. Owner's Name.
 3. Date of Recording.
 4. Project Name and Specification Number.
 5. Location and Standing Limit of audio-video.
- K. Prior to commencement of audio video recording, the Contractor shall notify the Engineer in writing when and where the audio video recording will begin. The Engineer may provide a designated representative to accompany and oversee coverage of all recording operations. Audio video recording completed without the Engineer's or his representative being present will be unacceptable unless specifically authorized by the Engineer.

PART 1 GENERAL

1.01 DESCRIPTION

- A. The Contractor shall provide temporary facilities and controls described herein for the duration of the project in order to complete the Work as shown and specified.

1.02 RELATED SECTIONS

- A. Supplementary General Conditions, General Conditions, other Technical Specifications, and Drawings apply to this section.

1.03 FIRST AID

- A. The Contractor shall provide a first aid station at the work site for joint use by personnel of the Contractor, the City, or any other visitors to the site.
- B. A first aid station shall meet or exceed all OSHA/Cal OSHA requirements for this construction project and have a dedicated emergency telephone line available.
- C. Qualifications of field personnel trained for first aid to comply with OSHA/Cal OSHA as well as compliance with all other OSHA/Cal OSHA requirements and proof of prior arrangements with hospital emergency admittance shall be included in the Contractor's Safety Plan submittal.

1.04 TEMPORARY WATER SERVICE

- A. The Contractor is responsible for securing and paying for construction water as specified in Paragraph 3.01 below. The Contractor shall also make all necessary arrangements for conveying the water to the points of use.
- B. Utilize Owner's existing water system, extend and supplement with temporary devices as needed to maintain specified conditions for construction operations. Use existing system until proposed system is brought online.

1.05 TEMPORARY ELECTRICAL FACILITIES

- A. Provide temporary electrical facilities as necessary to complete the project including supply of temporary lighting for work operations and temporary power for portable power-driven tools and temporary operation of installed equipment.
- B. Construct and maintain temporary electrical facilities in accordance with California Code of Regulations and requirements of the utility company providing the service. Materials, devices and equipment used in these facilities shall be in good and safe condition.
- C. Remove all temporary electrical materials and equipment furnished and installed by the Contractor after its use is completed.
- D. Use of engine generator sets, in lieu of utility company supply, or in combination with, is subject to the Engineer's approval. The City will not be responsible for any additional costs incurred by use of engine generator sets.

1.06 DEWATERING FACILITIES

- A. Provide and maintain temporary dewatering and pumping facilities, when necessary, to keep site reasonably dry and to protect materials and installed work from water damage.

1.07 SITE SECURITY

- A. The Contractor is responsible for securing site, building and grounds involved with this Project for the full duration of the Contract. The Contractor shall be responsible for all damages to work and loss of materials and equipment due to vandalism or theft.

1.08 CONSTRUCTION EQUIPMENT

- A. Erect, equip, operate, and maintain construction equipment in strict accordance with applicable laws, ordinances, rules, and regulations of authorities having jurisdiction and the construction documents.
- B. Provide and maintain scaffolding, staging, and similar equipment, as needed.

1.09 VEHICULAR ACCESS

- A. Vehicular access shall be in accordance with the Technical Specification titled “**Traffic Control.**”

1.10 PARKING

- A. Tracked vehicles are not allowed on paved areas.
- B. Use areas designated by the Engineer for parking equipment.
- C. Mud from Site Vehicles: Provide means of removing mud from vehicles wheels before entering streets. Wash or broom streets in a timely manner as directed by the Engineer.

1.11 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, crawl spaces, and other closed or remote spaces, prior to enclosing spaces.
- C. Broom and vacuum clean interior areas prior to start of surface finishing and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from site periodically and dispose off-site.

1.12 DUST CONTROL

- A. Execute the Work by methods to minimize raising dust from construction operations.
- B. Provide positive means to prevent air-borne dust from dispersing into atmosphere.
- C. Dust Control shall be in accordance with the Technical Specification titled “**Environmental Protection.**”

1.13 NOISE CONTROL

- A. Provide methods, means, and facilities to minimize noise from and noise produced by construction operations.
- B. Noise Control shall be in accordance with the Technical Specification titled “**Environmental Protection.**”

1.14 POLLUTION CONTROL

- A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.
- B. Comply with pollution and environmental control requirements of authorities having jurisdiction.
- C. Pollution Control shall be in accordance with the Technical Specification titled **Environmental Protection.**”

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 CONSTRUCTION WATER CONNECTIONS

- A. The Contractor shall not make connection to, or draw water from, any fire hydrant or pipeline without first obtaining permission from the public or private authorities having jurisdiction over the use of said fire hydrant or pipeline and from the public or private agency owning the affected water system.
- B. Construction water consumption charges will be billed to and paid for by the Contractor on a monthly basis. The Contractor is not required to pay a monthly service charge or to provide a meter deposit. The Contractor is required to pay the required fee for relocation of any construction meter and must provide a minimum of three (3) working days advance notice. Unless otherwise approved by the Engineer, only one construction meter will be provided. Additional meters will be subject to meter deposits and monthly service charges.
- C. For each such connection made, the Contractor shall first attach to the fire hydrant, or pipeline, an approved valve and an approved meter of a size and type acceptable to the Engineer. The Contractor will be granted privilege to draw water from an authorized point of connection as needed for the proper execution of said Contract.
- D. The Engineer reserves the right to remove the Contractor’s construction meter without prior notice for the Contractor’s failure to pay consumption fees, for water shortages, and for any unforeseeable circumstances which could negatively impact water service. The Contractor shall be fully responsible for total water consumption through the meter and for security of the construction meter.

3.02 INSTALLATION AND REMOVAL

- A. The Contractor shall provide temporary facilities for distribution and utilization of water and electric power as necessary for the completion of the Work described under this Contract and shall remove them from the Work site when no longer needed unless otherwise directed.

PART 1 GENERAL

1.01 SCOPE

- A. This section consists of providing a traffic control system for work within the City of Orland.

1.02 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled “**Submittals.**”
- B. Submit a Traffic Control and Work Site Safety Plan for the work site per Part 6, “Temporary Traffic Control,” of the Standard Specifications for Public Works Construction, these Specifications, and in consultation with Glenn County, and other applicable agencies.
- C. Submit a copy of the encroachment permits and riders obtained from applicable agencies.
- D. Submit a copy of approval of the traffic control plan obtained from applicable agencies.

PART 2 MATERIALS

2.01 CONSTRUCTION AREA TRAFFIC CONTROL DEVICES

- A. Flagging, signs, and temporary traffic control devices furnished, installed, maintained, and removed when no longer required shall conform to the provisions in Section 12, “Construction Area Traffic Control Devices,” of the Standard Specifications and the current edition of the California Manual on Uniform Traffic Control Devices.

2.02 PORTABLE CHANGEABLE MESSAGE SIGNS

- A. Portable changeable message signs shall comply with Section 12-3.32, “Portable Changeable Message Signs,” of the Standard Specifications.

PART 3 EXECUTION

3.01 TRAFFIC CONTROL PLAN

- A. The Contractor shall submit a traffic control plan conforming to the requirements of the City of Orland encroachment permit and Part 6 of the current edition of the California Manual on Uniform Traffic Control Devices (CAMUTCD), which shall be approved by the Owner prior to beginning work.

3.02 MAINTAINING TRAFFIC

- A. Maintaining traffic shall conform to the provisions in Sections 7-1.03, “Public Convenience,” Section 7-1.04, “Public Safety,” and Section 12, “Temporary Traffic Control,” of the Standard Specifications and this Technical Specification.
- B. Closure is defined as the closure of a traffic lane or lanes, including shoulder, within a single traffic control system.
- C. Closures shall conform to the provision in “Traffic Control System for Lane Closure” of this Technical Specification.

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- D. Full road closures are prohibited unless approved by Glenn County Director of Public Works.
- E. The Contractor shall provide safe and continuous passage for local pedestrian and vehicular traffic at all times.
- F. Work that interferes with public traffic shall be limited to the hours when lane closures are allowed, except for work required under Sections 7-1.03, "Public Convenience," and Sections 7-1.04, "Public Safety."
- G. The full width of the traveled way shall be open for use by public traffic for Designated Legal Holidays and Special Days.
- H. Designated Legal Holidays are:
 - 1. Monday, January 1, 2024 – New Year's Holiday.
 - 2. Monday, February 19, 2024 – Presidents' Day.
 - 3. Monday, April 1, 2024 – Cesar Chavez Day.
 - 4. Monday, May 27, 2024 – Memorial Day.
 - 5. Thursday, July 4, 2023 – Independence Day.
 - 6. Monday, September 2, 2024 – Labor Day.
 - 7. Friday, November 10, 2024 – Veteran's Day.
 - 8. Thursday and Friday, November 28 and 29, 2024 – Thanksgiving.
 - 9. Tuesday, December 24 and Wednesday, December 25, 2024 – Christmas Holidays.
 - 10. Tuesday, December 31, 2024, and Wednesday, January 1, 2025 – New Year's Holidays.
- I. Special Days are:
 - 1. Monday, January 15, 2024 – Martin Luther King Jr. Day.
- J. Local authorities shall be notified at least 5 business days before work begins. The Contractor shall cooperate with local authorities to handle traffic through the Work area and shall make arrangements to keep the Work area clear of parked vehicles.
- K. All public streets that are to be closed or interrupted due to construction activities will require coordination with the City of Orland Public Works Department, Glenn County Public Works Agency, and emergency services. A minimum of 3 business days' notice shall be given to these entities for said closures or interruptions.
- L. No work on local streets is allowed between 12:00 AM and 7:00AM and between 6:00PM and 12:00AM.
- M. Personal vehicles of the Contractor's employees shall not be parked on the traveled way or shoulders including sections closed to public traffic.
- N. Parking restrictions must be posted 24 hours before work starts and will be at the expense of the Contractor. Contact the police department, City of Orland Public Works Department, and Glenn County Public Works Agency when restrictions are placed.

- O. When work vehicles or equipment are parked within 6 feet of a traffic lane to perform active construction, the shoulder area shall be closed with fluorescent orange traffic cones or portable delineators placed on a taper in advance of the parked vehicles or equipment and along the edge of the pavement at 25-foot intervals to a point not less than 25 feet past the last vehicle or piece of equipment. A minimum of 9 traffic cones or portable delineators shall be used for the taper. A W20-1 (ROAK WORK AHEAD) or W21-5b (RIGHT/LEFT SHOULDER CLOSED AHEAD) or C24(CA) (SHOULDER WORK AHEAD) sign shall be mounted on a crashworthy portable sign support with flags. The sign shall be placed where designated by the Owner. The sign shall be a minimum of 48" x 48" in size. The Contractor shall immediately restore to the original position and location a traffic cone or delineator that is displaced or overturned, during the progress of work.
- P. If minor deviations from the lane requirement charts are required, a written request shall be submitted to the Engineer. The Engineer may approve the deviations if there is no significant increase in the cost to the Owner and if the Work can be expedited and better serve the public traffic.

3.03 TRAFFIC CONTROL SYSTEM FOR LANE CLOSURE

- A. A traffic control system shall consist of closing traffic lanes in conformance with the provisions in Section 12, "Temporary Traffic Control," of the Standard Specifications, the CAMUTCD and this Technical Specification.
- B. The provisions in this section will not relieve the Contractor of responsibility for providing additional devices or taking measures as may be necessary to comply with the provisions in Section 7-1.04, "Public Safety" of the Standard Specifications.
- C. During traffic stripe operations and pavement marker placement operations using bituminous adhesive, traffic shall be controlled, at the option of the Contractor, with either stationary or moving lane closures. During other operations, traffic shall be controlled with stationary lane closures. Attention is directed to the provisions of the City of Orland encroachment permit.
- D. If components in the traffic control system are displaced or cease to operate or function as specified, from any cause, during the progress of the Work, the Contractor shall immediately repair the components to the original condition or replace the components and shall restore the components to the original location.

3.04 STATIONARY LANE CLOSURE

- A. When lane closures are made for work periods only, at the end of each work period, components of the traffic control system, except portable delineators placed along open trenches or excavation adjacent to the traveled way, shall be removed from the traveled way and shoulder.
- B. Each vehicle used to place, maintain, and remove components of a traffic control system on multilane highways shall be equipped with a Type II flashing arrow sign which shall be in operation when the vehicle is being used for placing, maintaining, or removing the components. Vehicles equipped with Type II flashing arrow sign not involved in placing, maintaining or removing the components when operated within a stationary type lane closure shall only display the caution display mode. The flashing arrow sign shown on the approved traffic control plans shall not be used on the vehicles which are doing the placing, maintaining, and removing of components of a traffic control system and shall be in place before a lane closure requiring the sign's use is completed.

3.05 PORTABLE CHANGEABLE MESSAGE SIGNS

- A. Portable Changeable Message Signs shall be deployed on project streets to advise approaching drivers of the construction at each area of work. Approaching drivers must be able to read the entire message for all phases at least twice at the posted speed limit before passing portable changeable message sign. You may use more than 1 portable changeable message sign to meet this requirement.
- B. Only display the message ordered by the Owner or specified in this Technical Specification.
- C. The text of the message displayed on portable changeable message sign must not scroll, or travel horizontally or vertically across the face of the message panel.
- D. Continuously repeat the entire message in no more than 2 phases of at least 3 seconds per phase.
- E. If useable shoulder is at least 15 feet wide, the displayed message on portable changeable message sign must be minimum 18-inch character height. If useable shoulder area is less than 15 feet wide, you may use a smaller message panel with minimum 12-inch character height to prevent encroachment in the traveled way.
- F. Start displaying a road closed message on portable changeable message signs 5 days before closing each project street indicating the name of the road to be closed, the date of the closure and the times that the closure will begin and end.
- G. Place portable changeable message sign in advance of the first warning sign for:
 - 1. Each stationary lane closure.
- H. Place portable changeable message sign as far from the traveled way as practicable where it is legible to traffic and does not encroach on the traveled way. Place portable changeable sign before or at the crest of vertical roadway curvature where it is visible to approaching traffic. Avoid placing portable changeable message sign within or immediately after horizontal roadway curvature. Where possible, place portable changeable message sign behind guardrail or temporary railing (Type K).
- I. Except where placed behind guardrail or temporary railing (Type K) use traffic control for shoulder closure to delineate portable changeable message sign.
- J. Remove portable changeable message sign when not in use.
- K. The Contractor shall obtain an encroachment permit from the Glenn County Public Works Agency prior to placing changeable message signs within County right-of-way and from the City of Orland Public Works Department when within City right-of-way.

3.06 TEMPORARY PAVEMENT DELINEATION

- A. Temporary pavement delineation shall be furnished, placed, maintained, and removed in conformance with the provisions in Section 12-3.01, "General," of the Standard Specifications and these special provisions. Nothing in these special provisions shall be construed as reducing the minimum standards specified in the CAMUTCD or as relieving the Contractor from the responsibilities specified in Section 7-1.04, "Public Safety," of the Standard Specifications.

- B. When the Work causes obliteration of pavement delineation, temporary or permanent pavement delineation shall be in place before opening the traveled way to public traffic. Laneline or centerline pavement delineation shall be provided for traveled ways open to public traffic.
- C. Work necessary, including required lines or markers, to establish the alignment of temporary pavement delineation shall be performed by the Contractor. Surfaces to receive application of paint or removable traffic tape temporary pavement delineation shall be dry and free of dirt and loose material. Temporary pavement delineation shall not be applied over existing pavement delineation or other temporary pavement delineation. Temporary pavement delineation shall be maintained until superseded or replaced with a new pattern of temporary pavement delineation or permanent pavement delineation, or as determined by the Owner.
- D. Temporary pavement delineation shall be used on or adjacent to lanes open to public traffic for a maximum of 14 days. Before the end of the 14 days, if the permanent pavement delineation is not placed within the 14 days, additional temporary pavement delineation shall be provided by the Contractor at no additional cost to the Owner. The additional temporary pavement delineation to be provided shall be equivalent to the pattern specified for the permanent pavement delineation for the area, as determined by the Owner.
- E. Painted traffic stripe used for temporary delineation shall conform to Section 84-2, "Traffic Stripes and Pavement Markings," of the Standard Specifications, except for payment. The number of coats shall be, at the option of the Contractor, either one or 2 coats. The quantity of painted traffic stripe used for temporary delineation will not be included in the quantities of paint traffic stripe to be paid for.

3.07 TEMPORARY LANELINE AND CENTERLINE DELINEATION

- A. When lanelines or centerlines are obliterated, the minimum laneline and centerline delineation to be provided shall be temporary pavement markers placed at longitudinal intervals of not more than 24 feet. The temporary pavement markers shall be the same color as the laneline or centerline the markers replace. Temporary pavement markers listed for short term day/night use (14 days or less) or long-term day/night use (6 months or less) in "Prequalified and Tested Signing and Delineation Materials" of the Standard Specifications shall be used. Temporary pavement markers shall be placed in conformance with the manufacturer's instructions and shall be cemented to the surfacing with the adhesive recommended by the manufacturer, except epoxy adhesive shall not be used to place pavement markers in areas where removal of the markers will be required.
- B. Temporary laneline or centerline delineation consisting entirely of temporary pavement markers shall be placed on longitudinal intervals of not more than 24 feet.
- C. Full compensation for furnishing, placing, maintaining, and removing temporary pavement markers used for temporary laneline and centerline delineation and for providing equivalent patterns of permanent traffic for these areas when required shall be considered as included in the contract prices paid for the Site Management Bid Item and no separate payment will be made therefor.
- D. Full compensation for furnishing, placing, and maintaining temporary painted laneline and centerline pavement delineation shall be considered as included in the contract prices paid for the Site Management Bid Item and no separate payment will be made therefor.



PART 1 GENERAL

1.01 DESCRIPTION

- A. This section describes the requirements for the conservation and protection of environmental resources at the Work site during and as the result of construction activities, except as otherwise specified. State and federal environmental statutes, rules, regulations, and policies have been enacted to protect environmental resources by ensuring that significant environmental impacts of projects are identified, and adequate mitigation measures are incorporated into the Project. Environmental protection affects several resources areas, including biological resources, hydrology, and water quality. Potential impacts may occur through the generation of dust emissions, discharges of pollutants, disturbances to terrestrial and aquatic areas, additional traffic, and degradation of resources. Construction activities shall be in accordance with environmental and regulatory permits issued for the Project, and the Contractor may be held responsible for any violations as prescribed by law.
- B. The Contractor is responsible for complying with all terms and conditions of environmental and regulatory permits issued for the Project. Construction activities shall be in accordance with environmental and regulatory permits issued for the Project, and the Contractor may be held responsible for any violations as prescribed by law. Within this specification some, but not all of permit measures are explicitly incorporated. The Contractor is responsible for reading, understanding, and complying with all Project permits and applicable laws.
- C. The City is required by the regulatory agencies to suspend Work and recertify the Contractor's employees if there are environmental noncompliance infractions. If the Contractor's actions cause infractions, then the Engineer may suspend Work. The Contractor's personnel failing or refusing to carry out requirements of this section in the opinion of the Engineer shall be removed from the Work site if ordered.
- D. The Contractor shall be responsible for the sequence and control of construction activities, selection and maintenance of equipment, and the conduct of the Contractor's employees at the Work site to ensure that specific mitigation measures to reduce or eliminate identified environmental impacts are implemented.
- E. The Contractor shall minimize construction activities causing disturbances to vegetation or wildlife. Construction activities may be restricted in various ways that include, but are not limited to, the environmental protection and/or mitigation measures specified.

1.02 RELATED SECTIONS

- A. Supplementary General Conditions, General Conditions, Special Conditions, and Drawings apply to this section.

1.03 ENVIRONMENTAL REFERENCES

- A. Comply with all the terms and conditions of the documents list below.
 - 1. ESA – Federal Endangered Species Act of 1973, as amended.
 - 2. CESA – California Endangered Species Act of 1984.
 - 3. NHPA – National Historic Preservation Act of 1966, as amended (16 U.S.C.470).

4. CFC - California Fire Code, 2013 edition, Chapter 33 Fire Safety During Construction and Demolition.
5. CVC – California Vehicle Code, Section 23114.
6. Clean Water Act Section 402, NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities, also known as the State Water Resources Control Board Order No. 2009-0009-DWQ, Construction General Permit (CGP).
7. California Stormwater Quality Association (CASQA) – 2009 Construction BMP Handbook and SWPPP Preparation Manuals.
8. Caltrans Storm Water Quality Handbooks – Construction Site Best Management Practices (BMPs) Manual, 2003 and updated appendix dated September 1, 2004, to include BMP No. WM-8 for Concrete Waste Management.
9. The 2013 California Green Building Standards Code:
 - a. Section 5.408 – Construction Waste Reduction, Disposal and Recycling.
 - b. Chapter 8 – Compliance Forms and Worksheets.

1.04 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled “**Submittals.**”
- B. Develop and submit within 10 calendar days after the Notice to Proceed is issued in accordance with the Special Conditions detailed Plans for implementing the requirements of the permits obtained by the City and requirements of this section. The Plans shall include but not be limited to the following:
 1. Name of Contractor’s supervisor responsible for implementing the Plans.
 2. Working Drawings and data for implementing the requirements of the Plans.
 3. Air Quality Control Plan.
 4. Water Quality Control Plan and a Storm Water Pollution Prevention Plan (SWPPP).
 - a. Stormwater, water quality and other inspection and sampling reports and results and all other Project documentation required by the approved Stormwater Pollution Prevention Plan or Water Quality Control Program.
 5. Fire Prevention and Control Plan.
 6. Noise Abatement Plan.
 7. Construction Debris Recycling and Diversion Plan.
- C. Copies of all the above Plans shall be maintained at the Worksite throughout the construction period.

1.05 BOUNDARIES OF WORK SITE AND LISTED SPECIES

- A. The boundaries of the Work site will be designated by the Owner by flagging and staking or other similar method for showing exact location of Work and areas that may be occupied by the

Contractor. The Contractor and the Contractor's employees shall not leave the Work area, without prior written approval. If the Contractor or the Contractor's employees disturb such flagging, it shall be replaced by the Contractor as directed at no additional expense to the Owner.

- B. Surveys: Preconstruction surveys will be conducted within potential habitat for listed species and will designate exclusion zones. To the extent possible, the City will enact measures to clear the Work site of sensitive species and features such as relocation of sensitive species and inventory and removal of cultural resources.
- C. Exclusion Zones: Exclusion zone boundaries will be marked with either large, flagged stakes connected by cord, or survey laths or wooden stakes prominently flagged with survey ribbon or fencing. The Contractor and the Contractor's employees shall not encroach into flagged exclusion zones in any manner, whether in vehicles or on foot, without prior written approval.
- D. Adjustments to Right of Way: Within the right of way or temporary construction easement, the local Work area may be limited in extent to avoid removing or damaging trees.

1.06 DELIVERY, STORAGE, AND HANDLING OF HAZARDOUS MATERIALS

- A. Construction Sites and Equipment:
 - 1. The storage, transportation, transfer, containment, and disposal of hazardous materials, such as fuel, oil, and lubricants, have potential to impact water quality and contaminate soil. Fuel, oil and other petroleum products shall be stored only at designated sites. The use of hazardous materials shall be avoided or minimized where possible. Each hazardous material containment container shall be clearly labeled with its identity, handling and safety instructions, and emergency contact. Similar information shall be clearly available and visible in the storage areas. Storage and transfer of such materials shall not be allowed within 100 feet of streams or sites known to contain sensitive biological resources except with the permission of California Owner of Fish and Wildlife. Storage or use of hazardous materials in or near wet or dry streams shall be consistent with the Fish and Game Code and other State laws. Safety Data Sheets (SDS) shall be made readily available to the Contractor's employees and other personnel at the Work site. The accumulation and temporary storage of hazardous wastes shall not exceed 90 days. Soils contaminated by spills or cleaning wastes shall be contained and shall be removed to an approved disposal site. Disposal of hazardous wastes shall be in compliance with all applicable laws and regulations.
 - 2. Petroleum drippings on equipment have potential to result in water pollution and contaminate soil during construction. Maintain construction equipment to minimize petroleum drippings. Stationary power equipment such as engines, pumps, generators, welders, and air compressors shall be positioned over drip pans. Equipment shall be checked and maintained daily to keep the equipment exteriors clean.
 - 3. Petroleum products shall be stored in nonleaking containers at impervious storage sites from which runoff is not permitted to escape.
 - 4. Personnel stationed at or near these sites shall be trained in emergency response and spill containment techniques. An ample supply of absorbent pads, pillows, socks, booms, and other spill containment materials shall be maintained at the hazardous materials storage sites for use in the event of spills. Contaminated absorbent pads, pillows, socks, booms, and other spill containment materials shall be placed in nonleaking sealed

containers until transport to an appropriate disposal facility. The Contractor shall furnish to the Engineer a contact person and telephone number for a company experienced in emergency response for vacuuming and containing spills of oil or other petroleum products. The Contractor shall notify the Engineer immediately of an oil spill.

5. Fuel may be transferred from the storage areas to construction equipment by tanker trucks. Fuel transfers shall take place at least 100 feet from exclusion zones, drainages, and streams.
6. Fuel transfer vehicles shall have absorbent pads, pillows, socks, booms or other spill containment materials placed under the fueling operation (between the fuel truck and the equipment being serviced). A trained service attendant shall monitor the filling of equipment and shall stop the fuel flow immediately if any spill occurs. Fuel transfer shall not resume until the problem is resolved to the satisfaction of the Engineer. The service attendant shall be trained in emergency response, fire extinguisher use, and spill containment techniques.
7. No storage or use of hazardous materials or other construction activities in or near streams or wetlands.
8. When transferring oil or other hazardous materials from trucks to storage containers, absorbent pads, pillows, socks, booms, or other spill containment material shall be placed under the transfer area.

1.07 BIOLOGICAL RESOURCES (PLANTS AND ANIMALS)

- A. The construction activities have potential for affecting the biological resources by physical destruction, disturbance, and displacement. The Contractor is required to notify the Engineer if wildlife is encountered in the Project site.
- B. A City-approved biological monitor will be made available if necessary to conduct surveys, including preconstruction surveys, and to rescue and/or relocate State and federally listed species encountered during construction activities.
- C. Wildlife will be given an opportunity to escape during construction activities, or a biological monitor will rescue and relocate wildlife if needed.
- D. Every attempt will be made by the Contractor and the Contractor's employees (including subcontractors) to avoid harming wildlife within the construction site.
- E. The Contractor is prohibited from applying any rodenticide or herbicide to control any vertebrate or plant pest, without prior written approval.
- F. Disking work site areas is prohibited, even for fire protection, without prior approval.
- G. No pets, camping, firearms or any other use of the right of way, except for authorized construction activities, is allowed.
- H. Trash or garbage, including tobacco-related trash, and food-related trash, such as wrappers, cans, bottles, scraps, peels, and nut shells, is required to be removed to a county-approved disposal site at least weekly by the Contractor. The Contractor is required to inspect the right of way daily to ensure a clean, trash-free Work site.

- I. In the event wildlife is harmed or killed, a City-approved biological monitor will be informed of the incident and will be allowed to collect the specimen and all pertinent information associated with the incident.
- J. If the specimen is a State or federally listed species the appropriate agency will be informed.

1.08 AIR QUALITY CONTROL PLAN

- A. The construction activities have potential for resulting in localized, fugitive dust and combustion emissions from construction equipment, and trucks for hauling. Excessive emissions from equipment used for construction, transportation of personnel and materials to the Work site, portable pumps and generators, etc., have potential to increase atmospheric greenhouse gases (GHG) and adversely affect climate change. The Contractor assumes any liability of damage to surrounding resources caused by fugitive dust.
- B. Reduce these effects by submitting and implementing an Air Quality Control Plan. Generally, evaluate Project characteristics to determine if specific equipment, procedures, or material requirements are feasible and efficacious for reducing GHG emissions from the Project. Also, the following components shall be included in the plan.
- C. Fugitive dust shall be minimized by watering, applying chemical suppressant, or implementing other dust control measures as approved. Increased application of control measures shall be required whenever conditions cause fugitive dust. The Contractor shall control fugitive dust by:
 - 1. Minimizing areas cleared to facilitate dismantling and removal, such as storage areas, staging areas, stockpile areas and vehicle parking.
 - 2. Construction vehicles should be properly maintained in addition to limiting construction vehicle speeds on dirt roads to no greater than 15 mph.
 - 3. Covering haul vehicles or complying with the vehicle freeboard requirements of Section 23114 of the California Vehicle Code for both public and private roads.
 - 4. Installing track out plates or other similar methods where vehicles exit the construction site onto paved roads.
- D. The Contractor shall control other air pollutant emissions by:
 - 1. Evaluate Project characteristics, including location, Project workflow, Site conditions, and equipment performance requirements, to determine whether specifications of the use of equipment with repowered engines, electric drive trains, or other high-efficiency technologies are appropriate and feasible for the Project or specific elements of the Project.
 - 2. Prohibiting trucks and construction vehicles from idling in excess of five minutes when not in use.
 - 3. Maintain all construction equipment in proper working condition and perform all preventative maintenance. Required maintenance includes compliance with all manufacturer's recommendations, proper upkeep and replacement of filters and mufflers, and maintenance of all engine and emissions systems in proper operating condition. Maintenance schedules shall be detailed in an Air Quality Control Plan prior to commencement of construction.

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4. Implement a tire-inflation program on the Work site to ensure that equipment tires are correctly inflated. Check tire inflation when equipment arrives on-site and every two weeks for equipment that remains on-site. Check vehicles used for hauling materials off-site weekly for correct tire inflation. Procedures for the tire-inflation program shall be documented in an Air Quality Management Plan prior to commencement of construction.
 5. When materials are handled, loaded, unloaded, or transported on the Work site, the Work shall be performed by equipment using on-road rated engines to the extent feasible. On-road rated engines shall be equipped with the most recent engine pollution control equipment required by the California Air Resources Board (CARB).
 6. Schedule material transportation over public roadways during off-peak hours when possible. Off-peak hours shall be evaluated for each location and for the roadways intended for use. Such evaluation shall be included in the Traffic Control Plan.
 7. Limit deliveries of materials and equipment to off-peak traffic congestion hours to the extent feasible.
 8. For deliveries to project sites where the haul distance exceeds 100 miles and a heavy-duty Class 7 or Class 8 semi-truck or
 9. 53-foot or longer box type trailer is used for hauling, a SmartWay certified truck will be used to the maximum extent feasible.
 10. Develop a Project-specific ride-share program to encourage carpools, shuttle vans, transit passes and/or secure bicycle parking for construction worker commutes.
 11. Ensure that all feasible avenues have been explored for providing an electrical service drop to the construction site for temporary construction power. When generators must be used, use alternative fuels, such as propane or solar, to power generators to the maximum extent feasible.
 12. Reduce electricity use in temporary construction offices by using high-efficiency lighting and requiring that heating and cooling units be Energy Star compliant. Require that all contractors develop and implement procedures for turning off computers, lights, air conditioners, heaters, and other equipment each day at close of business when possible.
 13. Using only coatings and solvents in the proposed Project that are consistent with Air Quality Management District rules and all other applicable laws and regulations.
- E. Fugitive dust may contain naturally occurring asbestos. The Contractor shall control fugitive dust by:
1. Minimizing areas cleared to facilitate construction, such as storage areas, staging areas, stockpile areas, and vehicle parking.
 2. Covering spoil piles when necessary.
 3. Constructing roadways, driveways, sidewalks, building pads, and other graded surfaces.
 4. Chipping cleared vegetation and covering exposed areas as Work is completed.
 5. Minimizing the amount of construction equipment operating during any given time period. This includes scheduling of construction truck trips to reduce peak emission, limit the length of the construction workday, and phasing of construction activities.
 6. Covering haul trucks traveling onto or off the Work site. Haul trucks traveling on the Work site shall be covered as necessary to prevent dust from leaving the Work site.

7. Complying with CCR Title 17, Section 93105: Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations.
8. The Contractor shall acquire and comply with any permit required by the California Air Resources Board, Glenn County Air Pollution Control District, Glenn County Owner of Public Health.

1.09 WATER POLLUTION CONTROL IMPLEMENTATION

- A. Water pollution control measures, or BMPs, shall be implemented on a year-round basis at an appropriate level to minimize or prevent soil erosion and sediment discharges from leaving the construction site and/or entering a stormwater drainage system or receiving water. BMPs shall consist of an effective combination of both soil stabilization and sediment control measures.
- B. Active DSAs, during the rainy season, shall include soil stabilization measures installed prior to all predicted rain events and sediment control measures installed at all times. Active DSAs, during the non-rainy season, shall include soil stabilization measures and sediment control measures installed prior to predicted rain events.
- C. Non-active DSAs, during the rainy season, shall include soil stabilization measures installed within 14 days of cessation of soil disturbing activities or 1 day prior to all predicted rain event, whichever occurs first and sediment control measures installed at all times. Non-active DSAs, during the non-rainy season, shall include soil stabilization measures and sediment control measures installed within 14 days of cessation of soil disturbing activities or 1 day prior to all predicted rain event, whichever occurs first.

1.10 INSPECTIONS

- A. Inspections shall be conducted by the Contractor at the following minimum frequencies:
 1. Prior to a forecast storm.
 2. After a rain event that causes runoff from the construction site.
 3. At 24-hour intervals during extended rain events.
 4. Weekly during the rainy season.
 5. Every 2 weeks during the non-rainy season.
 6. At any other time(s) or intervals of time specified in these Technical Specifications.
 7. Inspections shall be completed under supervision of a Qualified SWPPP Practitioner (QSP) and/or Qualified SWPPP Developer (QSD).

1.11 REPORTING

- A. The Contractor shall notify the Owner immediately if one of the following occurs:
 1. Stormwater from a DSA is discharged to a storm drain system or waterway without treatment by an effective combination of temporary erosion and sediment control BMPs.
 2. Non-stormwater is discharged to a storm drain system or waterway without treatment by an effective combination of temporary erosion and sediment control BMPs.

3. Stormwater is discharged to a waterway or storm drain system where the control measures (BMPs) have been overwhelmed or not properly maintained or installed.
4. A discharge of hazardous substances occurs.
5. Stormwater is discharged to a waterway or storm drain system containing hazardous substances.
6. A discharge occurs that may endanger health or the environment.

1.12 FIRE PREVENTION AND CONTROL PLAN

- A. The Contractor shall submit an emergency fire prevention and control plan complying with all sections of the California Fire Code (CFC) Chapter 33 and acceptable to the Engineer. The fire plan shall include preventative measures, emergency procedures to be followed, current emergency telephone numbers, and an area map. The following components, if applicable, shall be included in the plan, and if not applicable the Contractor shall explain in the plan why that component or a portion thereof is not included in the plan:
1. Procedures and policies for preventing fires from occurring on site during construction, alteration, or demolition of any structures, including underground locations.
 2. Procedures and policies for controlling any fires that are on the Work site, access for firefighting and other related fire prevention and control procedures developed in consultation with resource agencies and fire protection agencies.
 3. No fires will be allowed at the Work site. Smoking will be allowed only in areas designated for smoking which shall be cleared of vegetation or in enclosed vehicles. Cigarette butts are to be disposed of in car ashtrays or other approved disposal containers and dumped daily in a proper receptacle off the Work site.
 4. Combustible debris, rubbish, and waste material shall be removed from buildings at the end of each work shift and shall not be disposed of by burning. Materials susceptible to spontaneous ignition shall be stored in a listed disposal container.
 5. Materials susceptible to spontaneous ignition are required to be stored in an approved disposal container.
 6. The Contractor shall be responsible for maintaining appropriate fire suppression equipment at the Work site including an all-wheel drive water truck or fire truck with a water tank of at least 3,000-gallon capacity. The truck's water tank shall be maintained full and shall not be used as a source of construction water without prior written approval by the Engineer. Fire extinguishers, shovels and other firefighting equipment shall be available at the Work site and on construction equipment. Each vehicle on the right of way shall be equipped with a minimum 20-pound (or two 10-pound) fire extinguisher(s) and a minimum of 5 gallons of water in a firefighting apparatus (e.g., bladder bag).
 7. At the Work site, a sealed fire toolbox shall be located at a point accessible in the event of fire. This fire toolbox shall contain: one back-pack pump-type extinguisher filled with water, two axes, two McLeod fire tools, and four shovels.
 8. Gasoline-powered construction equipment with catalytic converters shall be equipped with shielding or other acceptable fire prevention features. Internal combustion engines shall be equipped with spark arrestors. Motorized construction equipment shall be located such that the exhausts do not discharge against combustible materials, exhausts

piped to outside of building, equipment is fueled while in non-operation and fuel is stored in an approved area outside of the building.

9. Welding sites shall include fire prevention provisions.
10. Address flammable and combustible liquids or gases per CFC, Chapter 33.
11. The Contractor shall maintain contact with local firefighting agencies throughout the fire season for update on fire conditions, and such fire conditions shall be communicated to the Contractor's employees and the Engineer daily.
12. Vehicles are restricted to the Work site unless otherwise allowed for fire control procedures.
13. Disturbance to the terrestrial or aquatic environment through the use of heavy construction equipment shall be kept to a minimum. If a fire should start, the appropriate fire protection agencies responsible shall be contacted immediately. Hand crews, firefighting water trucks or other fire control measures may be used as a first defense. Only as required, heavy construction equipment shall be utilized to contain the fire or protect a structure from damage.

1.13 DUST CONTROL

- A. The amount of dust resulting from the Contractor's operations shall be controlled to prevent the spread of dust and to avoid creation of a health or safety hazard, or a nuisance in the Project site or surrounding areas. The Contractor shall provide continuous fugitive dust control measures at the Project site. Dust control shall be provided for, but not limited to, sludge material, the Contractor's laydown and Work areas, fueling and fuel storage areas, access and haul roads, stockpiles, embankment, slopes, borrow areas, excavations, disposal areas, and other site areas in which construction work is being performed, or that become potential sources of dust as a result of construction activities.
- B. Key elements of the Contractor's dust control program shall include:
 1. Water application.
 2. Covering loads of dust producing material.
 3. Dust suppressant application.
 4. Minimization of surface disturbance.
 5. Lowering vehicle speeds.
 6. Removing mud and dirt from vehicles prior to entering paved areas.
 7. Removing mud and dirt from paved areas.
- C. Use of water will not be permitted when it will result in, or create hazardous or objectionable conditions such as ice, flooding, and pollution. Use of dust suppressants shall be as approved by the Engineer. Calcium chloride shall not be used adjacent to concrete structures.

1.14 NOISE ABATEMENT

- A. Construction activities have the potential for resulting in localized, short- term noise impacts from construction equipment. The Contractor shall implement measures to minimize noise and vibration impacts. These measures include, but are not limited to:

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1. Do not operate construction equipment or run the equipment engines from 6:00 p.m. to 7:00 a.m. This includes all deliveries, traffic control setup, and service of construction equipment.
2. A noise level limit of 86 decibels at a distance of fifty feet (50') shall apply to all construction equipment on or related to the job whether owned by the Contractor or not. The use of excessively loud warning signals shall be avoided except in those cases required for the protection of personnel.
3. Performing preventive maintenance on equipment and devices to control, prevent and minimize noise.
4. All equipment, fixed or mobile, shall be equipped with properly operating and maintained exhaust and intake mufflers, consistent with manufacturers' standards.
5. Impact tools (e.g., jack hammers, pavement breakers, and rock drills) used for construction shall be hydraulically or electrically powered wherever possible to avoid noise associated with compressed air exhaust from pneumatically powered tools. Where use of pneumatic tools is unavoidable, an exhaust muffler on the compressed air exhaust shall be used. External jackets on the tools themselves shall be used where feasible.
6. Quieter procedures, such as use of drills rather than impact tools, shall be used whenever feasible.

1.15 CONSTRUCTION WASTE MANAGEMENT

- A. Waste Management Objective for the Project:
1. The City has established that this Project shall minimize the generation of construction and demolition waste at the site. Of the inevitable waste that is generated, as many of the waste materials as economically feasible shall be reused or recycled. Waste disposal in landfills shall be minimized. Recycle and/or salvage for reuse a minimum of 50 percent of the nonhazardous construction and demolition waste in accordance with Paragraphs 1.14 B and 1.14 C.
- B. The Contractor is required to minimize the generation of construction and demolition waste at the site through construction waste diversion and employment of techniques to reduce pollution through recycling of materials.
- C. The Contractor is required to recycle and/or salvage for reuse a minimum of 65 percent of nonhazardous construction and demolition waste in accordance with the 2016 California Green Building Standards Code Section 5.408; or meet a local construction and demolition waste management ordinance, whichever is more stringent.
- D. Diversion from Landfill: Waste categories appropriate for diversion from landfill shall include, but not be limited to, the following:
1. Soil and land clearing debris.
 2. Wood: Clean dimensional wood, palette wood.
 3. Sheet Wood: Plywood, OSB and particle board.
 4. Concrete.
 5. Concrete Masonry Units (CMU).

6. Asphalt concrete.
 7. Paper:
 - a. Bond.
 - b. Newsprint.
 - c. Cardboard and paper packaging materials.
 8. Cement Fiber Products: Panels and siding.
 9. Metals:
 - a. Ferrous.
 - b. Non-ferrous.
 10. Paint.
 11. Rigid foam.
 12. Glass.
 13. Plastics.
 14. Carpet and pad.
 15. Beverage containers.
 16. Insulation.
 17. Gypsum board.
 18. Porcelain plumbing fixtures.
 19. Light tubes (per Owner of Toxic Substances Control regulations).
- E. The Contractor is required to submit a Construction Waste Management Plan with the following components:
1. Identify the construction and demolition waste materials to be diverted from disposal by efficient usage, recycling, reuse on the Project or salvage for future use or sale.
 2. Identify if construction and demolition waste materials will be sorted on site (source-separated) or bulk mixed (single stream).
 3. Identify diversion facilities where construction and demolition waste material collected will be taken.
 4. Specify whether the amount of diverted construction and demolition waste materials shall be calculated by weight or volume, but not by both.
 5. Specify the waste management procedures utilized to oversee and document that the waste management goals are met.
 6. An estimate of total job site waste to be generated with material types and quantities. Also, an estimate of percentages of waste categories to be sent to the landfill, to be reused, or to be recycled.

PART 2 MATERIALS

2.01 FIBER ROLLS

- A. Fiber rolls shall consist of wood excelsior, rice or wheat straw, or coconut fiber that is rolled or bound into a tight tubular roll.

2.02 SILT FENCE

- A. Silt fence shall be woven polypropylene with a minimum width of 36 inches and a minimum tensile strength of 100 pounds. The fabric shall conform to ASTM D4632 and shall have an integral reinforcement layer. The reinforcement layer shall be a polypropylene, or equivalent, net provided by the manufacturer. The permittivity of the fabric shall be between 0.1 sec⁻¹ and 0.15 sec⁻¹ in conformance with ASTM D4491.

2.03 CRUSHED AGGREGATE

- A. Crushed aggregate shall be a minimum of 3 inches and maximum of 6 inches in size conforming with Section 72-2.02 of the State Standard Specifications.

2.04 TEMPORARY ENTRANCE FABRIC

- A. Temporary entrance fabric shall conform with Section 88-1.04 of the State Standard Specifications and be woven Type B or non-woven Type B.

2.05 GRAVEL BAGS

- A. Gravel bags shall consist of the following items:
1. A bag that is woven polypropylene, polyethylene or polyamide fabric, minimum unit weight 4 ounces per square yard, Mullen burst strength exceeding 300 psi in conformance with ASTM D3786, and ultraviolet stability exceeding 70 percent in conformance with the requirements in ASTM D4355. The use of burlap is not acceptable. Each bag shall have a length of 18 inches, width of 12 inches, thickness of 3 inches, and mass of approximately 33 pounds. Alternative bag sizes shall be approved by the Owner.
 2. Fill material shall be non-cohesive, Class 1 or Class 2 permeable material free from clay and deleterious material, conforming to Section 68-1.025 of the State Standard Specifications. The requirements for the Durability Index and Sand Equivalent do not apply. Fill material is subject to approval by the Owner.

2.06 WOOD STAKES

- A. Wood stakes shall be untreated fir, redwood, cedar, or pine and cut from sound timber. Stakes shall be straight and free of loose or unsound knots and other defects which would render stakes unfit for use and shall be pointed on the end to be driven into the ground.

2.07 STAPLES

- A. Staples used to fasten silt fence material to stakes shall be not less than 1.75 inches long and shall be fabricated from 0.06 inch or heavier wire. The wire used to fasten the tops of stakes together when joining two sections of fence shall be 0.12 inches or heavier wire. Galvanizing of the fastening wire is not required.

2.08 STRAW

- A. Straw shall conform with Section 20-2.06 of the State Standard Specifications.

PART 3 EXECUTION

3.01 FIBER ROLLS

- A. Fiber rolls shall be installed as required to intercept runoff, reduce runoff flow velocity, release runoff as sheet flow, and provide removal of sediment from runoff. Potential areas for fiber rolls include:
1. Along the toe, top, face, and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.
 2. Below the toe of exposed and erodible slopes.
 3. Down-slope of exposed soil areas.
 4. Around temporary stockpiles.
 5. Along the perimeter of the Project.
- B. Fiber rolls may be used for drain inlet protection if they can be properly anchored and if approved by the Owner.
- C. Fiber rolls shall be installed along level contours and shall be spaced as follows:
1. Slope inclination of flatter than 10:1: 50 feet.
 2. Slope inclination of 4:1 to 10:1: 20 feet.
 3. Slope inclination of 4:1 to 2:1: 15 feet.
 4. Slope inclination of 2:1 or greater: 10 feet.
- D. Before placing fiber roll, remove obstructions including rocks, clods, and debris greater than 1 inch in diameter from the ground.
- E. In locations to receive fiber rolls, excavate a concave 2- to 4-inch furrow and place excavated material on downhill side, place fiber roll within furrow ensuring there are no gaps under the fiber roll, drive wood stakes through the middle of the fiber roll 6 inches from the end of the roll and spaced at a maximum of 4 feet on center at all other locations. Stakes shall be driven into the soil so that the top of the stake is less than 2 inches above the top of the fiber roll. Wood stakes shall be 1 inch by 2 inch and a minimum length of 24 inches. If more than one fiber roll is placed in a row, the rolls shall be overlapped, not abutted, by a minimum of 18 inches.
- F. Fiber rolls shall be inspected prior to forecast precipitation, following precipitation, and at least daily during prolonged rainfall. Split, torn, unraveling, or slumping fiber rolls shall be repaired or replaced. Fiber rolls shall be repaired or adjusted when rills and other evidence of concentrated runoff is visible. Sediment along fiber rolls shall be removed when the sediment accumulation reaches 1/3 of the barrier height. Removed sediment shall be incorporated in the Project at locations designated by the Owner.

- G. Fiber rolls may be left in place at the approval of the Owner. If fiber rolls are removed, collect and dispose of sediment accumulation, and fill and compact holes, trenches, depressions or any other ground disturbance to blend with adjacent ground.

3.02 SILT FENCE

- A. Silt fence shall be installed as required to intercept and slow the flow of sediment-laden sheet flow runoff. Potential areas for silt fence include: below the toe of exposed and erodible slopes, down-slope of exposed soil areas, around temporary stockpiles, and along the perimeter of the Project.
- B. The bottom of silt fence shall be keyed-in a minimum of 6 inches. Trenches shall not be excavated wider and deeper than necessary for proper installation of silt fence. Excavation of trenches shall be performed immediately before installation of silt fence. Silt fences shall be located at least 3 feet from the toe of slopes unless otherwise approved by the Owner. Silt fence shall be installed along level contours. Wood stakes shall be 2 inch by 2 inch and a minimum length of 48 inches.
- C. Silt fences shall be inspected prior to forecast precipitation, following precipitation, and at least daily during prolonged rainfall. Undercut, split, torn, slumping, or weathered silt fence shall be repaired or replaced. Sediment along silt fences shall be removed when sediment accumulation reaches 1/3 of the barrier height. Removed sediment shall be incorporated in the Project at locations designated by the Owner. Silt fences that are damaged and become unsuitable for their intended purpose, as determined by the Owner, shall be removed, and replaced by the Contractor.
- D. Once silt fences are not required for the Project, the Contractor shall remove and dispose of the fences. The Contractor shall fill and compact holes and trenches, remove sediment accumulation, and grade fence alignment to blend with adjacent ground.

3.03 STABILIZED CONSTRUCTION ENTRANCE/EXIT

- A. Prior to beginning construction, the Contractor shall locate a staging area. The location of the staging area shall be approved by the Owner. The staging area shall be adequate to store materials, equipment, portable restroom facilities, concrete washout area, stockpiles, solid waste, and hazardous waste. If the approved staging area is unimproved, a Stabilized Construction Entrance/Exit (SCE) shall be installed, and all access and egress shall be limited to this location. The location of the SCE shall be approved by the Owner.
- B. The SCE location shall be prepared by removing vegetation to ground level and clearing debris, grading ground to a uniform plane to prevent runoff from leaving the Project, removing sharp objects that may damage fabric, and compacting the top 1 foot of soil to at least 90 percent relative compaction. The SCE shall be crushed aggregate over temporary entrance fabric that is a minimum 50 feet long, 20 feet wide, and 1 foot thick. As the SCE approaches the existing road the width shall be increased to accommodate vehicle turning movements. Overlap sides and end of fabric by at least 12 inches. Do not drive on fabric until crushed aggregate has been placed.
- C. The SCE shall be inspected routinely for damage and to assess the effectiveness. The SCE shall be repaired if fabric is exposed, depressions in the SCE surface develop, or if aggregate is displaced. Remove crushed aggregate and separate and dispose of sediment as necessary and as directed by the Owner.

- D. Once the SCE is not required for the Project, the Contractor shall remove and dispose of all materials and backfill and repair ground disturbance, including holes and depressions.

3.04 STRAW MULCH

- A. Straw mulch shall be installed on disturbed soil areas as required prior to the onset of precipitation for soil stabilization. Potential areas for straw mulch are: exposed soil areas and exposed temporary stockpiles.
- B. Straw mulch shall be applied by a straw blower or by hand. Straw shall be applied at a minimum rate of 4,000 pounds per acre. The mulch shall be anchored to the soil with a tackifier or by using mechanical methods (crimping, punch roller, track walking). If stabilizing emulsion is used, roughen soil by rolling with a crimping or punching-type roller or by track walking before placing mulch. The quantity of tackifier must be as recommended by the manufacturer. The ratio of water to fiber and tackifier in the mixture must be as recommended by the manufacturer. Straw mulch shall be evenly distributed on the soil surface. Straw mulch shall not be placed onto the traveled way, sidewalks, drainage channels, walls, fences, or existing vegetation. Straw mulch with tackifier shall not be applied during or immediately before precipitation, if water is standing on or moving across the soil surface, if the soil is frozen, or if the air temperature is below 40°F during the tackifier curing period unless allowed by the manufacturer and approved by the Owner.
- C. Straw mulch shall be inspected prior to forecast precipitation, following precipitation, and at least daily during prolonged rainfall. Straw mulch shall evenly cover DSAs without any exposed soil areas. Reapply straw mulch within 24-hours of discovering visible erosion. Straw mulch disturbed or displaced by the Contractor's vehicles, equipment, or operations must be reapplied. The Contractor shall repair any damaged mulch areas and re-mulch any exposed areas.
- D. Once straw mulch is not required for the Project, the Contractor shall remove and dispose of all mulch. Straw mulch can be mechanically blended into the soil with track laying equipment, disking, or other approved method. Areas damaged during activities shall be re-graded per the Plans.

3.05 WIND EROSION CONTROL

- A. All exposed soil areas shall be watered to prevent excessive amounts of dust. Watering, with complete coverage, shall occur at least twice daily, preferably in the late morning and after Work is complete for the day. All clearing, grading, earth moving, or excavation activities shall cease when winds exceed 25 miles per hour averaged over 1 hour. The area disturbed by demolition, clearing, grading, earth moving, or excavation operations shall be minimized at all times. Haul trucks shall be covered with tarpaulins or other effective covers at all times.

3.06 STREET SWEEPING AND VACUUMING

- A. Visible sediment tracking shall be swept and/or vacuumed daily. Street sweeping must be done at paved roads at job site entrance and exit locations, and at paved areas within the job site that flow to storm drains. All paved areas shall be kept clear of sediment and debris.

3.07 VEHICLE AND EQUIPMENT CLEANING

- A. Onsite vehicle and equipment washing or cleaning is discouraged. When vehicle/equipment washing/cleaning must occur onsite, the Contractor is required to notify and receive approval

from the Owner prior to each occurrence. Washing/cleaning areas shall be located away from storm drain inlets, drainage facilities, or watercourses.

3.08 VEHICLE AND EQUIPMENT FUELING

- A. Onsite vehicle and equipment fueling shall only be used where it's impractical to send vehicles and equipment offsite for fueling. When fueling must occur onsite, the Contractor shall select and designate an area to be used, subject to approval of the Owner. Absorbent spill clean-up materials and spill kits shall be available in fueling areas and on fueling trucks and shall be disposed of properly after use. Drip pans or absorbent pads shall be used during vehicle and equipment fueling, unless fueling is performed over an impermeable surface in a dedicated fueling area. If a spill occurs, the Contractor shall notify the Owner and immediately clean up the spill and properly dispose of contaminated soil and cleanup materials.
- B. Dedicated fueling areas shall be protected from stormwater run-on and runoff and shall be located at least 50 feet from downstream drainage facilities. Fueling areas shall be protected with berms and/or dikes to contain spills. Fueling must be performed on level-grade areas. Nozzles used in vehicle and equipment fueling shall be equipped with an automatic shut-off to control drips. Fueling operations shall not be left unattended. Fuel tanks shall not be "topped off". Vehicles and equipment shall be inspected on each day of use for leaks. Leaks shall be repaired immediately, or problem vehicles or equipment shall be removed from the Project site.

3.09 VEHICLE AND EQUIPMENT MAINTENANCE

- A. Vehicle and equipment maintenance shall not occur within the Project.

3.10 PAVING AND GRINDING OPERATIONS

- A. Substances used to coat asphalt transport trucks, asphalt trucks, and asphalt spreading equipment shall not contain soap and shall be non-foaming and non-toxic. Plastic materials shall be placed under asphaltic concrete paving equipment while not in use. Sand, gravel, spilled asphalt, or other materials from paving operations shall not enter storm drainage facilities and shall be recovered by the Contractor and disposed of as directed by the Owner.
- B. Removed pavement material shall be collected and properly disposed of by the Contractor. Residue from portland cement concrete and asphalt concrete grinding/saw-cutting operations shall be picked up by means of a vacuum system or sweeping and shall not be allowed to flow into the storm drainage system. Pavement removal, pavement grinding, and saw-cutting operations shall not be conducted in the rain.
- C. All thermoplastic striping and pre-heater equipment shutoff valves shall be inspected to ensure that they are working properly to avoid leaking. The pre-heater shall be filled carefully to prevent spilling of thermoplastic. The Contractor shall not pre-heat, transfer, or load thermoplastic near storm drain facilities or watercourses. Thermoplastic waste shall be properly disposed of by the Contractor.

3.11 STORM DRAIN INLET PROTECTION

- A. Storm drain inlets and catch basins located downstream of construction activities shall have water pollution control devices installed to capture sediment. The number and locations of control devices shall be as directed by the Owner.

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- B. Storm drain inlet protection shall consist of filter fabric placed on the grate with either a gravel bag barrier or combination of fiber rolls with gravel bags placed upstream of grate to filter stormwater and collect sediment.
- C. Inspect all inlet protection devices before and after every rainfall event and weekly during the rest of the rainy season. During extended rainfall events, inspect inlet protection devices at least once every 24-hours. Sediment shall be removed when the sediment accumulation reaches 3/4 of the barrier height. Removed sediment shall be incorporated in the Project at locations designated by the Owner.

3.12 SPILL PREVENTION PLAN

- A. The Contractor shall provide a Spill Prevention Plan to the Owner for approval prior to beginning any Work.



PART 1 GENERAL

1.01 SCOPE

- A. This section describes the requirements for Project identification and signs.
- B. Standard drawing for Project identification signs is included in **Attachment A** of this section. Project identification signs shall be constructed in accordance with these Specifications.
- C. Furnish all labor, materials, and equipment for Project identification and signs as specified herein.
- D. Commercial advertising matter shall not be attached to or painted on the surfaces of the signs.
- E. No signs, except those specified, shall be displayed, unless otherwise accepted by the City.

1.02 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled "**Submittals.**"
- B. The Contractor shall submit the following for acceptance within 30 days of the Notice to Proceed:
 - 1. Type of grade of materials.
 - 2. Layout, size, trim, framing, supports, and coatings.
 - 3. Size and style of lettering.
 - 4. Samples of colors.
- C. Prior to fabrication of the signs, submit a "mock-up" sample of the proposed sign(s), information, and graphics for review and acceptance by the Owner.

PART 2 MATERIALS

2.01 GENERAL

- A. The structure and framing shall be allowed to be new or used, wood or metal, in sound condition, structurally adequate to work and suitable for specified finish. The sign surfaces shall be exterior softwood plywood with medium density overlay, standard large sizes to minimize joints; the thickness shall be as required by standards to span framing members and to provide even, smooth surface without waves or buckles. The rough hardware shall be galvanized.
- B. The size of the signs and lettering shall be as specified herein. The sign colors for structure, framing, sign surfaces and graphics shall be uniform colors throughout the Project, shall comply with the requirements specified herein, and shall be as selected by the Owner.
- C. The signs shall be painted signs, with painted lettering. Finishes and painting shall be exterior quality, adequate to resist weathering and fading for the duration of the Project. Use bulletin colors for graphics.
- D. Signs can be wrapped if the Contractor can provide details and assurances that signs will be adequate to resist weathering and fading for the duration of the Project.

2.02 CONSTRUCTION OF SIGNS

- A. Use 3/4-inch exterior grade plywood or approved equal, unless shown otherwise.
- B. Use trim, mitered on all edges.
- C. Design signs and supports to withstand 75 mile-per-hour wind.
- D. Paint with exterior gloss-finish enamel. Sign painter shall be a professional in the type of work required.

PART 3 EXECUTION

3.01 INSTALLATION AND MAINTENANCE


- A. Location of signs shall be as shown or directed by the Owner.
- B. Provide the necessary mounting posts and hardware.
- C. Maintain signs so they are clean, legible, and upright. Keep grass and weeds cut away from signs.
- D. If required by progress of the Work or Owner, sign(s) shall be relocated to other acceptable site(s).
- E. Repair and repaint damaged structure, framing, and/or signs.
- F. Remove signs, framing, supports and foundations at completion of Project or when directed by the Owner.

Attachment A to 01580

Standard Detail for Project and Information Signs

Small Community Drought Relief Program
Program Sign Guidelines

NAME OF PROJECT
FOR
NAME OF PUBLIC AGENCY



Funding for this project has been provided in full or in part from the State Department of Water Resources.

FINANCED UNDER THE
Small Community Drought Relief Program

ADMINISTERED BY
CALIFORNIA STATE DEPARTMENT OF WATER RESOURCES

ENGINEER:
CONTRACTOR:

4' to 8'

3' to 5'

- This is a conceptual design sketch that is NOT to scale.
- Provide adequate structural supports for sign as site conditions may require.
- Keep sign a proper distance above prevailing grade to permit public viewing.
- Size DWR logo to permit public viewing.
- Paint letters blue (Blue No.15102 in federal color standard No.595).
- DWR Logo at: <https://d3.water.ca.gov/owncloud/index.php/s/s8CFdC3cvgf9v9p/download>



PART 1 GENERAL

1.01 SCOPE

- A. This section describes the startup and testing requirements of the pump station after all work is completed and prior to acceptance of the facility.
- B. Electrical testing shall be in accordance with Division 16 Technical Specifications.

1.02 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

- A. AMERICAN WATER WORKS ASSOCIATION(AWWA)
 - 1. AWWA E101 (1988) Vertical Turbine Pumps - Line Shaft and Submersible Types
- B. HYDRAULIC INSTITUTE
 - 1. ANSI/HI 9.6.4 Rotodynamic Pumps for Vibration Measurements and Allowable Values
- C. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
 - 1. NEMA MG 1 (2009) Motors and Generators INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA) PUBLICATIONS
 - 2. Maintenance Testing Specifications for Electric Power Distribution Equipment and Systems
 - 3. Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems
- D. INSTRUMENT SOCIETY OF AMERICA (ISA)

1.03 DESCRIPTION

- A. Perform the start-up and commissioning tests as specified herein, as shown on the approved Plans, or as otherwise directed by the Engineer. These start-up and commissioning tests are required to verify the satisfactory installation, adjustment, operation and performance of all equipment and materials erected and installed under this Specification. Operational and commissioning tests will determine the suitability for Owner's acceptance of the Contractor's work and verify the equipment was manufactured and installed in accordance with AWWA E101.
- B. The Division of Drinking Water (DDW) requires the demonstration test of the water treatment facilities before connecting to the existing drinking water system. The water distribution shall be temporarily connected to the pump to waste line downstream of the new treatment facilities until DDW approves connecting to the existing drinking water system. Therefore, the startup activities shall be connected to the pump to waste piping during the start-up activities and the demonstration test. The connection to the existing waterline to the existing water distribution system shall not be completed until DDW authorizes connection to the system.
- C. Unless specified otherwise, start-up and commissioning testing required herein shall be performed under the supervision of Contractor and/or subcontractor that supplied and installed

the facilities involved in the testing. If a supplier stipulates that their presence is required as condition of their equipment warranty, the supplier must also witness the tests.

1.04 SUBMITTALS

- A. The following shall be submitted in accordance with the Technical Specifications "Submittal":
- B. Preconstruction Submittals Testing and Operation Plan
- C. Shop Drawings
 - 1. Wiring schedule designating each circuit to be tested
- D. Product Data
 - 1. List of drawings and manuals to be used for each test
- E. Samples
 - 1. Sample Test Form
- F. Test Reports
 - 1. Test Reports

PART 2 PRODUCTS

2.01 TESTING

- A. Comply with the respective manufacturer's recommendations, and the Specifications herein.
- B. Comply with Occupational Safety and Health Act (OSHA) as to safety, clearances, padlocks, and barriers around electrical equipment energized during testing.
- C. The company furnishing the test instruments shall have a calibration program which maintains all applicable test instrumentation within rated accuracy. The accuracy shall be traceable to the National Bureau of Standards in an unbroken chain. Instruments shall be calibrated every six (6) months and shall bear dated calibration labels near the meter face.
- D. All test instruments selected for use in the work shall be for the purpose for which they are used and shall be recognized as such.
- E. Contractor shall be responsible for all costs of the field tests, including related services of the manufacturer's representative, except for water, which the City will bear.
- F. The Contractor shall provide temporary power if permanent power has not been secured. The City will submit an application to PG&E for permanent power.

2.02 TESTING AND OPERATION PLAN

- A. A minimum of one (1) month before commencement of field testing and operation, submit a plan which includes:
 - 1. Schedule for tests to be performed

2. List of equipment to be inspected, tested, and operated during each test
 3. Test procedure for completion of each proposed test
 4. Wiring schedule designating each circuit to be tested
 5. List of drawings and manuals to be used for each test
 6. Sample visual and mechanical inspection checklist
 7. List of testing equipment to be used.
 8. Sample Test Form
 9. Sample test form for documenting test results, including:
- B. Insulated Conductor Test
- C. Pump Test

2.03 TEST REPORTS

- A. Submit completed test reports, along with the Operation and Maintenance Manuals. Provide original report and an electronic copy, signed and witnessed by the Design Engineer and manufacturer's representative, if required. Submit one (1) certified original and four (4) separately bound copies of test reports within three (3) weeks of test completion. Test reports shall include:
1. Project name, Contractor, testing date(s), and report date
 2. Description of equipment tested
 3. Description of test
 4. Test personnel
 5. List of test equipment used and calibration date
 6. Test results, date, and weather conditions
 7. A schedule showing the "as-built" settings
 8. Conclusions and recommendations
 9. Appendix, including all test forms

PART 3 EXECUTION

3.01 VISUAL AND MECHANICAL INSPECTION

- A. General
1. Perform visual and mechanical inspections of all mechanical and electrical equipment, piping and conduit runs, prior to start of testing. Complete a Visual and Mechanical Checklist including the following inspection points.
 2. Cleanup and Touch Up. Prior to inspection, thoroughly clean all equipment to remove all dirt, grease, grit, metal filings, and any other foreign matter. Touch-up scratches, utilizing manufacture's standard paint.
 3. Anchorage and Support. Verify proper support of equipment, anchor installation, and tightening of bolts and anchors.

4. Adjustment and Lubrication. Verify adjustment, alignment and
5. lubrication of equipment in accordance with manufacturer's recommendation.
6. Nameplate Data. Confirm nameplate data with specifications, submittals, and associated equipment. Record model numbers, serial numbers, and setting information for all equipment and components.
7. Manufacturer's Manuals and Instructions. Verify installation in accordance with manufacturer's instructions, complete all installation checklists, and fill in manufacturer's provided forms. Verify certificate of manufacturer including requirements associated with NEMA MG 1. Confirm all manufacturer's operation and maintenance manuals and instructions are complete and on-site for testing and preparation of the facility operation and maintenance manual.

3.02 START-UP TESTING

- A. General. After system installation and pre-operational testing is complete, conduct start-up testing in accordance with the manufacturer's instructions and as specified herein. Provide all materials and labor and perform the tests in the presence of the Owner's representative and the Engineer. The Contractor will make arrangements to have manufacture representative of the perchlorate and chlorine systems available for one day to assist with operation of their systems during the startup activities.
- B. Tests and inspections shall include, but are not limited to the following:
- C. Pump. The pumping unit shall be given a running field test in the presence of the Owner for a minimum of four (4) hours. Each pumping unit shall be operated at its rated capacity or such other point on its head-capacity curve selected by the Owner.
 1. All field tests shall be conducted using potable water.
 2. The Manufacturers representative shall assist the Contractor in the proper conduct of each pumping unit field acceptance test.
 3. The following field testing shall be conducted:
 - a. Start-up check and operate the pump system over its entire speed range. If the pump is driven by Variable Frequency Drive, the pump and motor shall be tested at 100 RPM increments. vibration shall be within the amplitude limits specified in ANSI/HI 9.6.4 at a minimum of four (4) pumping conditions defined by the Engineer.
 - b. Obtain concurrent readings of motor voltage, amperage, pump suction head, and pump discharge head for at least four pumping conditions at each pump rotational speed. Check each power lead to the motor for proper current balance.
 - c. Assure that in the manual and automatic modes each pump responds to its start/stop signal based on the pressure set points by manually adjusting the high and low-pressure level signals from the pressure transmitter.

- d. Determine bearing temperatures by contact type thermometer. A run time until bearing temperatures have stabilized shall precede this test, unless insufficient liquid volume is available.
 - e. Electrical and instrumentation tests shall conform to the requirements of the sections under which that equipment is specified.
4. Provide an accurate method of measuring the discharge flow from each pump and the pressure head at pump discharge.
- D. Valves. Verify configuration, installation, lubrication, and condition of materials, in accordance with Specifications and manufacturer's instructions. Operate gates manually through full range of motion.
- E. Building Services. Complete testing and adjustment of all building services systems, including HVAC, water supply, septic and plumbing in accordance with applicable specification sections and manufacturer's recommendations.
- F. Electrical and Control Systems. Perform visual and mechanical inspection, pre-operational testing, and control system functional testing.

3.03 COMMISSIONING DEMONSTRATION

- A. After successful completion of the start-up testing detailed above, in the presence of the Owner and Engineer, conduct an operational demonstration of all systems to verify Contract compliance.

3.04 DEMONSTRATION AND TRAINING

- A. Demonstrate operation and maintenance of the equipment and systems to the Owner's personnel, a minimum of two (2) weeks prior to date of substantial completion. Utilize operation and maintenance manuals as a basis for demonstration. Review contents of manuals with Owner's personnel.
- B. Demonstrate start-up, operation control, adjustment, troubleshooting, servicing, and maintenance schedules. Contractor shall schedule a minimum of two 8-hour days on-site for demonstration and training of Owner staff. The Owner will perform sampling of the treatment system and reporting to DDW.

3.05 FAILURE TO MEET START-UP AND COMMISSIONING REQUIREMENTS

- A. If, in the opinion of the Owner, the start-up testing or commissioning demonstration results indicate improper adjustment, operation, or performance of any equipment, and these deficiencies are due to negligence or unsatisfactory installation by the Contractor, the Contractor shall remedy the situation and repeat the testing and demonstration at no additional cost to the Owner.

3.06 FINAL ADJUSTMENT AND CLEANING

- A. Clean all equipment.
- B. Replace filters of operating equipment.
- C. Make final adjustments under the supervision of the Engineer and Owner.



PART 1 GENERAL

1.01 SCOPE

- A. This section describes the requirements for Project As-Built documents (Drawings and Specifications) and survey of completed pipelines and appurtenances.
- B. The Contractor shall maintain, at the job site, one complete set of Contract Specifications and Plans, Addenda, Change Orders, Construction Memoranda, other directions, and approved submittals. The Contractor shall also maintain, at the job site, one As-Built set of Technical Specifications and full-size Plans marked to show any deviations which have been made from the Contract Plans, approved shop drawings, or Contract Specifications, including buried or concealed construction and utility features which are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated or which were not indicated on the Plans. Said As-Built drawings and Specifications shall be supplemented by any detailed sketches as necessary or directed, to indicate fully the Work as actually constructed.

1.02 DEFINITIONS

- A. As-Built Drawings: Drawings prepared by the Contractor, which show, in red ink, on-site changes to the original issued for construction drawings.
- B. As-Built Specifications: Specifications prepared by the Contractor, which show, in red ink, on-site changes to the issued for construction specifications.
- C. As-Built Survey: GPS survey prepared by the City Professional Land Surveyor licensed in the State of California, which shows the location of points, structures, etc. as specified herein.
- D. Substantial Completion: Substantial completion shall be defined after startup and commissioning activities are completed.

1.03 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled "**Submittals.**"
- B. Submit Draft As-Built Drawings and Specifications for Engineer's review.
- C. Submit final As-Built Drawings and Specifications.
- D. Submit GPS survey file format and accuracy tolerances (horizontal and vertical).
- E. Submit As-Built Survey in a format acceptable to the Engineer.
- F. Submit the Draft O&M of the project prior to start up and commissioning activities.
- G. Submit the final O&M after the startup and commissioning activities are completed.

1.04 Operations and Maintenance Manuals

- A. Provide four (4) original O&M manuals and one (1) electronic copy (in pdf) of the pump station, associated piping and storage tank system to the Engineer prior to substantial completion of the

project. All O&M manuals shall be provided in a three-ring binder, with tabs and an index describing the contents of the binder. One binder containing the O&M manual for each piece of equipment shall be furnished and be included in a separate binder. All O&M manual copies whose original pages are color shall be provided in color. The binder cover sheet shall include at a minimum: (1) the name of the project; (2) the contents of the binder; (3) the Owners name; (4) the date; and (5) the volume number (i.e. Vol 1 of 2 etc.). One hardcopy of the O&M manual shall be provided to the Engineer and Owner for review prior to reproducing all four sets. Once the sample copy has been approved, the Contractor may proceed with preparing the four original sets.

1. Operation and maintenance instructions shall include, at a minimum, the below listed data for each item of mechanical, electrical, and instrumentation equipment. All equipment manufacturers shall be made aware of these requirements and all associated costs shall be included in the costs for furnishing the equipment or system.
2. All information provided as part of the Shop Drawings.
3. All information required as part of equipment Specification Section.
4. Manufacturer's O&M manual customized for equipment provided. Cross out equipment not provided.
5. Bill of material listing every component of equipment listed by make and part number. An insufficient bill of materials shall result in O&M manual submittal rejection.
6. An itemized list of all data provided.
7. Name and location of the manufacturer, the manufacturer's local representative, the nearest supplier, and spare parts warehouse.
8. Equipment function, normal operating characteristics, and limiting conditions.
9. Recommended maintenance procedures during storage of equipment prior to installation and after installation but prior to start-up.
10. Recommended installation, adjustment, start-up, calibration, and troubleshooting procedures.
11. Recommended lubrication, lubrication intervals, and an estimate of yearly quantity needed.
12. Recommended step-by-step procedures for all modes of operation. Operating instructions for startup, routine and normal operation, regulation and control, shutdown, and emergency conditions. Instructions shall include keystrokes and procedures required for adjusting control setpoints for equipment operation.
13. Complete internal and connection wiring diagrams of actual installation.
14. Equipment maintenance.
15. Test data and performance curves, where applicable.
16. Recommended preventive maintenance procedures and schedule.
17. Complete parts lists (bill of materials), by generic title and identification number (part number), with exploded views of each assembly.

- a. Every component shall be listed on the bill of material with its corresponding part number.
 - 1) A recommended spare parts list shall include generic title and identification numbers (part numbers).
 - 2) Recommended spare parts and any special tools required.
 - 3) Disassembly, overhaul, and reassembly instructions.
 - 4) Factory and field test results (if applicable).
 - 5) Manufacturer's contact information and local certified service representative's contact information.
- B. Following completion of an item, instructions and procedures shall be modified by the Contractor to reflect field changes. In addition, the O&M manuals shall contain reproducible prints in full size drawings (11" X 17" minimum) of the Contract record wiring diagrams, schematics, and installation drawings required. Information not applicable to equipment installed in the Work shall be excluded.
- C. Individual O&M manuals shall be broken into sections and indexed. Under each section there shall be a description of the operation and maintenance, and installation instructions of each item. Sections shall be labeled and each item shall be sub-labeled. No acceptance of equipment will be made until the individual O&M manual has been approved. Contractor's copy of each individual O&M manual shall be available at the site of the Work for use by field personnel and the Engineer during start-up and testing of the equipment.
- D. Operation manuals and maintenance manuals shall be submitted as specified in the General Provisions and the Technical Specifications, but no later than 30 Calendar Days prior to Substantial Completion. Operation manuals and maintenance manuals provided in a common volume shall be clearly differentiated and shall be separately indexed and shall include all warranty information and certificates.
- E. O&M manuals for the electrical equipment is specified in the Division 16 specifications.

1.05 QUALITY ASSURANCE

- A. Surveyor Qualifications: Engage a Professional Land Surveyor licensed in the State of California, to perform required surveying services.
- B. Engineer Qualifications: Engage a Professional Engineer of the discipline required, licensed in the State of California, to perform specified engineering services, shoring, excavation and pit design and other engineering required to execute the Contractor's construction methods.
- C. Survey Equipment: The instruments and other survey equipment shall be accurate, suitable for the surveys required, and in proper condition and adjustment at all times.
- D. The Engineer may perform field observations and testing to determine if the Work is being performed in accordance with the Contract Documents. The Contractor shall cooperate with the

Engineer and shall make any necessary provisions to allow for the safe observation, inspection, and testing of the Contractor's work.

PART 2 MATERIALS

2.01 NOT USED

PART 3 EXECUTION

3.01 AS-BUILT DOCUMENTS

- A. Current As-Built Drawings and Specifications shall be accessible to the Owner and Engineer at all times during the construction period. They shall be reviewed with the Owner and/or Engineer at regular intervals.
- B. As-Built Drawings and Specifications shall be clearly and correctly annotated by the Contractor to show all changes made during the construction process at the time the changed Work is installed.
- C. Upon completion and prior to final inspection of the Work, the Contractor shall submit the As-Built Drawings and Specifications to the Engineer for review and shall make such revisions or corrections as may be necessary for them to be a true, complete, and accurate record of the Work in the opinion of the Engineer. When approved, the Contractor shall deliver the final As-Built Drawings and Specifications to the Engineer.

3.02 AS-BUILT DRAWING SURVEY

- A. Survey to be performed by the City.
- B. In addition to the survey requirements listed in the General Conditions, the City shall conduct a Global Positioning System (GPS) survey of the pipeline alignments prior to backfilling, where applicable. GPS survey accuracy shall be a minimum of 3 to 6 centimeters vertically and 1 to 3 centimeters horizontally. The GPS survey shall provide a vertical and horizontal position for each of the following:
 - 1. Top of the pipe, every change in horizontal or vertical alignment, and every 500 feet minimum, or as directed by the Engineer.
 - 2. Each existing system connection.
 - 3. Pipeline material transition.
 - 4. Each fitting (HPI and VPI).
 - 5. Each lateral.
 - 6. Each valve box.
 - 7. Each tracer wire access box).
 - 8. Each air valve.
 - 9. Each blowoff and/or end of line.
 - 10. Each existing utility Crossing (beginning and end).
 - 11. Top of concrete encasement (beginning and end).

12. Foundation elevations and corners.
 13. Discharge pipe from tank.
 14. Electrical panels.
 15. Each Fence Gate Post and Corner Posts.
 16. All new asphalt concrete roadways.
- C. Surveyor's Notes: Copies of all calculations, cut sheets, and field notes provided by the Professional Land Surveyor for constructing the Work shall be provided to the Engineer upon request.
- D. Data collected from the GPS survey shall be in a format suitable to import to a Geographic Information Systems (GIS)-based map. The Contractor shall provide the accuracy tolerances both horizontally and vertically from the GPS survey for Engineer approval.
- E. The As-Built survey shall be performed by a Professional Land Surveyor licensed in the State of California.

3.03 EXAMINATION

- A. The City shall perform construction surveying. Prior to removal for improvements, the Contractor shall verify line and grades shown on the Plans. Any questionable grade, elevation, or location shall be brought to the immediate attention of the Engineer in writing for clarification prior to construction.
- B. The construction staking grades shall be prepared by a California licensed Land Surveyor and be consistent with the grades on the construction drawings. No asphalt or concrete work shall be placed prior to the Engineer's approval of the construction staking grades. All costs involved in providing survey verification, including resurveying and verification of design grades, shall be included in the construction surveying bid item and no additional compensation will be made.
- C. Identification: The Contractor shall identify and perpetuate all existing survey control points and property line corner survey monuments or offsets.
- D. The Contractor shall verify information shown on the Drawings, in relation to the property lines and existing benchmarks, before proceeding to lay out and stake the Work. The Contractor is responsible for locating and protecting benchmarks and control points, and to preserve permanent reference points during construction.
1. Do not change or relocate benchmarks or control points without prior written approval from the Engineer. Promptly report lost or destroyed reference points or requirements to relocate reference points because of necessary changes in grades or locations.
 2. Promptly replace lost or destroyed Project control points. Replacement control points shall be based on the original survey control points.
- E. Establish and maintain a minimum of two permanent benchmarks, referenced to data established by survey control points.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

- F. Existing Utilities and Equipment: The existence and location of underground and other utilities, structures, and construction indicated as existing are not guaranteed. Before beginning Site work, investigate and verify the existence and location of underground utilities and other construction.
1. Prior to construction, verify the location and invert elevations at points of connection to existing water piping.

3.04 PERFORMANCE

- A. Work from lines and levels established from the survey control shown on the Drawings, or as provided by the Engineer. Establish benchmarks and markers to set lines and levels at each segment of construction and elsewhere as needed to locate each element of the Project. Use dimensions provided on civil drawings to determine locations of improvements.
1. Advise subcontractors engaged in construction activities of marked lines and elevations provided for their use, and of the responsibility to protect and preserve these points.
 2. As construction proceeds, incorporate horizontal and vertical checks to verify the location of key and/or major improvements and meet existing conditions.
- B. Surveyor's Field Notes: Maintain surveyor's Field Notes of control and other survey work. Make the field notes available for reference.
1. Record deviations from design grade, profiles and elevations, and advise the Engineer when deviations exceed industry standards for maintaining design criteria. On Project Record Drawings, record deviations that are accepted and not corrected.
- C. Existing Utilities: Furnish information necessary to adjust, move, or relocate existing structures, utility poles, lines, services, or other appurtenances located in or affected by construction. Coordinate with local authorities having jurisdiction.

3.05 RECORDS

- A. Survey data shall be recorded in accordance with recognized professional surveying standards. Original field notes, computations, and other surveying data shall be recorded on electronic data collectors or in standard field books and must be of sufficient quality to enable the Contractor to prepare accurate record drawings as required by the Contract Documents.

3.06 QUANTITY SURVEYS

- A. The Contractor shall perform such surveys and computations as are necessary to determine quantities of Work performed or placed during each progress payment period and shall perform all surveys necessary for the Engineer to determine final quantities of Work in place. The Engineer will determine final quantities based upon the survey data provided by the Contractor, and the design lines and grades. If requested by the Engineer, the Contractor shall provide an electronic copy of data used for quantity computations.
- B. All surveys performed for measurement of final quantities of Work and material shall be subject to approval by the Engineer. Unless waived by the Engineer in each specific case, quantity surveys made by the Contractor shall be verified by the Engineer.

PART 1 GENERAL

1.01 SCOPE AND DESCRIPTION

- A. This section covers all Work required to remove existing Site and street facilities, including but not limited to, concrete curbs, gutters, sidewalks, asphalt pavement, guardrail, existing ditches/channels, and all objectionable material from the Project site within the limits of the proposed construction. Removed facilities shall be disposed of, salvaged, replaced in kind, reset, relocated, or reconstructed as specified in these Specifications, as shown on the Plans, or as directed by the Engineer.
- B. Provide materials, equipment and labor required to execute this Work as indicated on the Drawings, specified herein and necessary to complete the Work of this section.

1.02 DEFINITIONS

- A. Structures and Surface Features: Existing structures and surface features including buildings, roads, signs, posts, utility poles, monitoring wells, fences, trees, shrubs, landscaped surface features, pipe cleanouts, and other miscellaneous items.
- B. Utilities: Existing electric lines and conduits, telephone and other communication lines and conduits, leachate transfer pipe, other utilities, and appurtenances.
- C. Monitoring Devices: Site monitoring wells, staff gauges, windsocks, and benchmarks or any other feature associated with compliance monitoring at the Site.
- D. Clearing and Grubbing: Cutting and disposing of trees, brush, windfalls, logs, and other vegetation, and removing and disposing of roots, brush, stumps, logs, and other vegetation.
- E. Salvaged Topsoil: Natural loam, sandy loam, silt loam, silty clay loam, or clay loam humus-bearing soils available from overlying portions of areas to be excavated for construction.

1.04 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled “**Submittals.**”
- B. The Contractor shall submit the following:
 - 1. Plans and Operations
 - a. Proposed plans, details, methods, and equipment to be used for clearing, grubbing, and demolition operations.
 - b. Sequence of operations for clearing, grubbing, and demolition.
 - c. Proposed temporary stockpile areas.
 - d. Locations intended for disposal of the demolition materials.
 - e. Recycle locations for recyclable materials. Documentation of such recycling.

02100 - CLEARING, GRUBBING, AND DEMOLITION

2. Construction Material Handling Plan. Submit plan 7 days prior to Project commencement and update on a monthly basis. The details of the plan shall include:
 - a. Material quantities and associated schedule of excavation and hauling.
 - b. Hauling routes and safety procedures.
 - c. Stockpiling areas with projected quantities and protection measures.
 - d. General fill placement methods for each component of the Project.
3. If required, Demolition Permit Release and Asbestos Notification forms are to be submitted to the Glenn County Air Pollution Control District.

1.05 FIELD CONTROL

- A. Provide the necessary field survey per the Technical Specification section titled "**As-Built Project Documents and Surveys**" to assure compliance with the lines and grades shown on the Drawings.
- B. Place and maintain barricades and safety signs as needed for safety per the Technical Specification sections titled "**Traffic Control**" and "**Signage.**"
- C. Measures to control dust and noise shall be in accordance with the Technical Specification section titled "**Environmental Protection.**"
 1. Promptly clean up loose excavation dirt and sweep clean all usable portions of roadway and walks as the Work progresses to prevent dirt from being scattered. Promptly and regularly apply water or dust palliative to all dust and dirt areas, including stockpiles, to prevent dust from being a nuisance. The cost of preventative and corrective measures taken by the Contractor shall be included in the bid items and therefore no additional payment will be made.

1.06 QUALITY ASSURANCE

- A. All line and elevation work shall be completed by a Civil Engineer licensed to do survey work or a licensed land surveyor.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 GENERAL

- A. Existing facilities which are to remain in place shall be protected in conformance with State Standard Specifications 5-1.36. Trenches, holes, depressions, and pits caused by the removal of facilities shall be backfilled with Class II aggregate base material as provided in the Technical Specification section titled "**Excavation, Backfill, and Compaction.**"

02100 - CLEARING, GRUBBING, AND DEMOLITION

- B. Clearing and grubbing shall be in accordance with Section 17-2 of the State Standard Specifications and these Contract Documents. Areas shown on the Plans shall be cleared and grubbed as applicable. No payment will be made to the Contractor for clearing and grubbing outside these limits unless the Work is authorized in writing by the Engineer. The area above the natural ground surface shall be cleared of all vegetation, such as trees, logs, upturned stumps, roots of down trees, brush, grass, weeds, and other objectionable material. Clearing and grubbing shall be performed in advance of trenching operations and in accordance with the requirements specified in these Contract Documents.
- C. All materials removed, which are not to be salvaged or reused, shall become the property of the Contractor, and shall be removed from the Site by the Contractor. Demolition and disposal shall be in accordance with Section 14 of the State Standard Specifications and these Contract Documents. The Contractor shall be responsible for obtaining a suitable disposal site in accordance with the Special Conditions. The dumping ground site shall be in accordance with all Federal, State, and Local laws. Seek and obtain such approval and file with the Owner and Engineer copies of all approvals or agreements so obtained.
- D. Salvaged materials shall be delivered to the Owner's Public Works Department or other agreed upon site.

3.02 MEETING

- A. Prior to the start of clearing, grubbing, and demolition operations, a field meeting shall be held with the Engineer to discuss limits, temporary stockpiling, and disposal of material. The Contractor is required to coordinate this meeting.

3.03 CONSTRUCTION METHODS

- A. Construction methods shall comply with all applicable sections of the Standard Specifications for Public Works Construction (SSPWC), latest edition, unless noted otherwise herein.

3.04 SITE CONDITIONS

- A. It is the Contractor's responsibility to verify Site conditions and perform the demolition, clearing, and grubbing required to place and install all items shown and specified.
- B. Protection:
 - 1. Care shall be exercised during demolition work to confine such work to the demolition area. The Contractor shall take the necessary steps and use the necessary equipment to adequately protect adjacent structures and properties from any damage. The physical means and methods used for protection are at the Contractor's option.
 - 2. Safe passage of persons around the area of demolition shall be provided. Operations shall be conducted to prevent injury to people and damage to adjacent buildings, structures, and other facilities.
 - 3. Existing landscaping materials, structures, and appurtenances not to be demolished shall be protected and maintained as necessary. The Contractor shall protect and maintain all other utilities during the demolition work.
 - 4. Contact utilities "811 Dig" and the Engineer to locate public and private utilities prior to beginning any excavation.

02100 - CLEARING, GRUBBING, AND DEMOLITION

5. Locate existing underground utilities by hand excavation, if necessary.
 6. Interior and exterior shoring, bracing, and supports shall be provided to prevent movement, settlement, deformation or collapse of structures to be demolished.
 7. If uncharted utilities are encountered during excavation, immediately stop Work, place Work in a safe condition, and notify the Engineer.
 8. Preserve and protect groundwater monitoring wells, trees, shrubs, culverts, benchmarks, cleanouts, and other items. If damaged during construction, notify the Engineer immediately. The Contractor will replace or repair damaged items at the Contractor's expense.
 9. Cap or remove and relocate services. Protect, support, and maintain conduits, wires, pipes, or other utilities that are to remain in place during Work.
 10. The Contractor shall protect other existing equipment from dust caused by demolition activities by covering, drop-curtains, and other similar.
 11. Protect benchmarks, survey control points, and existing structures from damage or displacement.
 12. Existing trees shall be removed only as shown on the Plans and as directed by the Engineer.
- C. Worker Protection:
1. The Contractor is responsible for the health and well-being of its workers during the execution of this Contract. The Work shall be conducted in accordance with all applicable local, State, and federal regulation.
- D. Explosives and Burning:
1. Not permitted in performance of demolition work.

3.05 EXAMINATION

- A. Examine the areas and conditions under which Work of this section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.
- B. Locate existing exposed and buried active utilities and determine the requirements for their protection, or their disposition with respect to the demolition work.
- C. Verify existing plant life designated to remain is tagged or identified.
- D. Identify Salvage area for placing removed materials.

3.06 LIMITS

- A. Clearing and preparation operations shall be confined to the limits shown on the construction plans. Only specified access roads, as shown, shall be used for operation.

3.07 PERMITS

- A. All permit requirements shall be complied with during the course of the Work, both for transportation and disposal of materials.

3.08 STOCKPILES

- A. Topsoil shall be stockpiled at the location as directed by the Engineer. Stockpile shall be placed, graded, and shaped to promote proper drainage of stockpile area.

3.09 CONCRETE CURB, GUTTER, SIDEWALK, AND DRIVEWAYS

- A. Concrete curb, gutter, sidewalk, and driveways shall be removed at the locations shown on the Plans or as directed by the Engineer. Removal shall be to the lines and elevations shown, specified, or determined by the Engineer. Existing concrete shall be cut to a true line where new concrete is to join existing concrete. Existing concrete sidewalk and curb and gutter to be removed shall be cut to a true line at the closest score line or expansion joint beyond the excavation or the location shown on the Plans. Residue from saw-cutting shall be picked up by means of a vacuum device. Residue shall not be allowed to flow across the pavement and shall not be left on the surface of the pavement. Gravel bags shall be placed in the gutter pan prior to saw-cutting. Gravel bags shall remain in gutter pan until construction has been completed in that area. Concrete removal operations shall be performed without damage to any portion that is to remain in place. Damage to the existing concrete, which is to remain in place, shall be repaired to a condition equal to that existing prior to the beginning of removal operations. The cost of repairing existing concrete damaged by the Contractor's operations shall be at the Contractor's expense.

3.10 ASPHALT CONCRETE

- A. Asphalt concrete shall be cut and removed to a true line at the location shown on the Plans or as directed by the Engineer. Residue from saw-cutting shall be picked up by means of a vacuum device. Residue shall not be allowed to flow across the pavement and shall not be left on the surface of the pavement. Gravel bags shall be placed in the gutter pan prior to saw-cutting. Gravel bags shall remain in the gutter pan until construction has been completed in that area. Asphalt concrete removal operations shall be performed without damage to any portion that is to remain in place. Damage to the existing asphalt concrete, which is to remain in place, shall be repaired to a condition equal to that existing prior to the beginning of removal operations. The cost of repairing existing concrete damaged by the Contractor's operation shall be at the Contractor's expense.

3.11 GUARDRAIL

- A. Guardrail shall be removed and re-installed at the locations shown on the Plans. All materials removed which are not to be salvaged or reused, shall become property of the Contractor, and shall be removed from the Site by the Contractor. The Contractor shall be responsible for obtaining a suitable disposal site in accordance with the Special Conditions.

3.12 TRAFFIC STRIPES, PAVEMENT MARKINGS AND MARKERS

- A. Traffic stripes and pavement markings shall be removed by any method that does not materially damage the existing pavement. Pavement marking images shall be removed in such a manner that the old message cannot be identified. Where grinding is used, the pavement marking image shall be removed by grinding a rectangular area. The minimum dimensions of the rectangle shall be the height and width of the pavement marking. Residue resulting from removal operations shall be removed from pavement surfaces by sweeping or vacuuming before the residue is blown by the action of traffic or wind, migrates across lanes or shoulders, or enters into drainage facilities. Traffic stripes shall be removed before any change is made in the traffic pattern.

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- B. Pavement markers, including underlying adhesive, shall be removed by such methods that will cause the least possible damage to the pavement or surfacing. Damage to the pavement or surfacing caused by pavement marker removal shall be repaired by the Contractor at the Contractor's expense by methods acceptable to the Engineer. During the removal of ceramic type pavement markers, screens or other protective devices shall be furnished to contain any fragments as provided for in State Standard Specification 7-1.04. Fragments resulting from the removal of pavement markers shall be removed from the road before the lane or lanes are opened to public traffic.

3.13 DRAINAGE FACILITIES

- A. Existing culverts, storm drain pipelines, inlets, manholes, or other drainage structures where shown on the Plans shall be removed and disposed of. Resulting openings into existing structures that are to remain in place shall be plugged with concrete conforming to Section 90-2 of the State Standard Specifications. The concrete shall contain not less than 505 pounds of cementitious material per cubic yard. The ends of culverts and storm drain pipelines shall be securely closed by a 0.5-foot-thick tight fitting plug or wall of commercial quality concrete. Trenches, holes, depressions, and pits caused by the removal of drainage facilities shall be backfilled with Class 2 aggregate base material as provided in the Technical Specification section titled "**Excavation, Backfill, and Compaction.**"
- B. Drainage ditches to be abandoned shall be backfilled as specified on the improvement plans.

3.14 CONCRETE

- A. Concrete shall be removed at the locations shown on the Plans or as directed by the Engineer. Removal shall be to the lines and elevations shown, specified, or determined by the Engineer. Existing concrete shall be cut to a true line where new concrete is to join existing concrete. Concrete removal operations shall be performed without damage to any portion that is to remain in place. Damage to the existing concrete, which is to remain in place, shall be repaired to a condition equal to that existing prior to the beginning of removal operations. The cost of repairing existing concrete damaged by the Contractor's operations shall be at the Contractor's expense.

3.15 SIGNS, SIGNPOSTS, AND SIGN FOUNDATIONS

- A. Existing signs, signposts, and sign foundations as shown on the Plans shall be removed and disposed of in a legal manner. Holes, depressions, and pits caused by the removal of signs, signposts, and sign foundations shall be backfilled with Class 2 aggregate base material as provided in the Technical Specification section titled "**Excavation, Backfill, and Compaction,**" unless otherwise noted on the Plans or directed by the Engineer. Existing signs, signposts, and sign foundations shall not be removed until replacement signs have been installed or until the existing signs are no longer required for the direction of public traffic, unless otherwise directed by the Engineer.

3.16 FENCE

- A. Where shown on the Plans, existing fences shall be removed and rebuilt to conform to the new construction work. Fences shall be rebuilt with the same or better materials and shall be painted to match the existing fence.

3.17 SEWERAGE AND STORM FACILITIES

- A. Where shown on the Plans, existing pipe, manholes, structures, diversion boxes, portions of the influent headworks shall be removed and stockpiled onsite at a location specified by the City. Trenches, holes, depressions, and pits caused by the removal of sewerage, or storm facilities shall be backfilled with Class 2 Aggregate Base material as provided in the Technical Specification section titled “**Excavation, Backfill, and Compaction.**”

3.18 SURFACE RESTORATION

- A. Restore existing utilities, surface features, and structures to condition equal to condition which existed prior to construction.
- B. Replace to original condition or better, damaged landscape work such as trees, shrubs, and grass outside of construction limits in accordance with the Technical Specifications.
- C. Clean the ground and debris from the Site and dispose of at state or county licensed waste disposal sites.
- D. All demolition debris shall be disposed of off-site in a lawful manner. Materials from the demolition shall not be used for backfilling.
- E. Backfill all excavations after demolition work. Backfill shall be in accordance with Technical Specification section titled “**Excavation, Backfill, and Compaction.**” Fill all excavations with engineered material, compact, and finish grade to blend with surrounding Site. For unpaved private roads, the Contractor shall replace cover in kind and to the extent as shown.

3.19 SALVAGE

- A. The City has the right to salvage any items scheduled for removal. The Contractor shall notify the Engineer five (5) days prior to any salvage or demolition work to determine the disposition of items to be removed. The Engineer will mark items to be salvaged. Such items shall be properly disconnected, removed from their foundations, cleaned, and stored at a designated location.

3.20 CLEANING

- A. During and upon completion of Work, the Contractor shall promptly remove unused tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by the Work in a clean condition in accordance with the Supplementary General Conditions and General Conditions.
- B. The Contractor shall clean adjacent structures and facilities of dust, dirt, and debris caused by demolition and return adjacent areas to the condition that existed prior to start of Work.
- C. The Contractor shall clean and sweep the affected portions of roads, streets, sidewalks, and passageways daily.

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PART 1 GENERAL

1.01 WORK INCLUDES

- A. Information related to results of existing subsurface investigations completed at the Site.
- B. Requirements for additional subsurface investigations if desired and proposed by the Contractor.

1.02 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled “**Submittals.**”
- B. Subsurface Exploration Plan.

1.03 REFERENCES

- A. Geotechnical Data Report by Allerion Consulting Group, Inc., dated October 2022.

1.04 SUBSURFACE SITE CONDITIONS

- A. Information related to the subsurface conditions is presented in the Geotechnical Engineering Study by Allerion. Additional interpretation of the subsurface information is also presented in the Contract Drawings.
- B. The Owner will furnish a copy of the Geotechnical Data Report to the Contractor for review.
- C. The Contractor is expected to review the information contained in the Geotechnical Data Report and on the Drawings as part of their duties to familiarize themselves with the Site.
- D. Results and information presented in the Geotechnical Data Report apply only to the locations at which data was collected, at the specific time it was collected. Geotechnical conditions may differ elsewhere on the Site.

1.05 ADDITIONAL INVESTIGATIONS

- A. The Contractor may, at no cost to the Owner, complete additional subsurface investigations using rotary borings, rotosonic methods, test pits or other approved methods at the Site to further investigate the subsurface conditions as they relate to the Work.
- B. The Contractor shall submit a proposed Subsurface Exploration Plan, gain permission from the Owner, and obtain all necessary permits and approvals prior to completing any additional subsurface investigation work.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED



PART 1 GENERAL

1.01 SCOPE AND DESCRIPTION

- A. This section describes the requirements for protection and location of existing utilities and facilities; and materials, testing, and performance of trench excavation, backfilling, and compacting.
- B. The requirements include excavating, backfilling, and compacting for the following:
 - 1. Foundations.
 - 2. Water Tank Ringwall Foundation.
 - 3. Pump Building Structure.
 - 4. Earthen Pads,
 - 5. Water Pipelines.
 - 6. Fittings.
 - 7. Air Valve Assemblies.
 - 8. Thrust Blocks.
 - 9. Other items, as shown.
- C. Provide materials, equipment and labor required to execute this Work as indicated on the Drawings, specified herein and necessary to complete the Work of this section.

1.02 REFERENCES

- A. The following publications form a part of this Specification to the extent referenced.
 - 1. American Society for Testing and Materials (ASTM):
 - a. ASTM C 138 Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
 - b. ASTM C 403 Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance.
 - c. ASTM D 75 Standard Practice for Sampling Aggregates.
 - d. ASTM D 422 Standard Test Method for Particle-Size Analysis of Soils.
 - e. ASTM D 1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone.
 - f. ASTM D 1557 Standard Test Method for Laboratory Compacting Characteristics of Soil Using Modified Effort.
 - g. ASTM D 2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

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- h. ASTM D 2321 Underground Installation of Thermoplastic and Sewers Other Gravity-Flow Applications.
 - i. ASTM D 2419 Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
 - j. ASTM D 2487 Classification of Soils for Engineering Purposes.
 - k. ASTM D 4832 Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
 - l. ASTM D 4253 Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - m. ASTM D 4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - n. ASTM D 4643 Standard Test Method for Determination of Water Content of Soil and Rock by Microwave Oven Heating.
 - o. ASTM D 5971 Standard Practice for Sampling Freshly Mixed Controlled Low-Strength Material.
 - p. ASTM D 6024 Standard Test Method for Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application.
 - q. ASTM D 6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
2. California Test (CT):
- a. CT-216 Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates.
 - b. CT-231 Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates Using Nuclear Gauge.
3. Cal/OSHA (California Title 8, Division 1, Chapter 4).
4. California Department of Industrial Safety.
5. Standard Specifications, State of California Department of Transportation (Caltrans), latest edition.
6. California Labor Code – Section 6705.
7. Construction Safety Orders of the California Division of Industrial Safety.
8. Project Geotechnical Investigations:
9. Geotechnical Data Report by Allerion Consulting Group, Inc., dated October 2022.
- a. Standard Specifications for Public Works Construction (SSPWC):

1.03 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled “**Submittals.**”
- B. Product Data:
 - 1. Submit certification, gradations, classification, and source for onsite and imported materials proposed to be used in the Work. Sample sizes shall be as determined by testing laboratory and approved by the Engineer.
 - 2. The slurry, CLSM, and concrete mix designs, prepared by the manufacturer, showing compliance with the specified properties.
 - 3. Geotextile Fabric.
- C. Shop drawings shall be submitted showing excavation and shoring, bracing, or sloping for worker protection in accordance with the General Conditions. The Contractor shall comply with the provisions for “Shoring and Bracing Drawings” in Section 6705 of the California Labor Code. The Contractor, prior to beginning any trench or structure excavation five feet deep or over shall submit to the Engineer and shall be in possession of the Engineer’s written acceptance of the Contractor’s detailed plan showing design of all shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or structure excavation. If such plan varies from the shoring system established in the Construction Safety Orders of the State of California, such alternative system plans shall be prepared by a Civil or Structural Engineer licensed in the State of California.
- D. Equipment and Methods
 - 1. Excavation equipment specifications and methods.
 - 2. Compaction methods and equipment specifications for all structures, roadways, foundations, and pipelines, including bell holes and pipe haunches.
 - 3. If required by the Engineer, dewatering means and methods.
 - 4. Submit proposed means and methods to support box culverts and utilities greater than 12-inches in size.
- E. Proposed field sampling and testing laboratory.
- F. Submit Owner inspection requests prior to backfill the following a minimum of seventy-two (72) hours in advance:
 - 1. Scarification and preparation of pad and foundation/slab subgrades.
 - 2. Trench subgrade.
 - 3. Where required, prior to placing re-fill material.
 - 4. Trench compacted material per compaction testing intervals and frequency.
 - 5. Placing geotextile fabric.
 - 6. Placing structural fill material over geotextile and encapsulation.

7. Forming the foundation, slab, or footing over compacted fill encapsulated in geotextile fabric.
8. Placing crushed rock ground cover.

1.04 DEFINITION OF ZONES

- A. Pavement Zone shall include the asphaltic concrete and aggregate base pavement section placed over the street zone. This zone is often referred to as the “structural section” of the street or highway.
- B. Trench Zone shall include the portion of the trench from the top of the pipe zone to the bottom of the pavement zone in paved areas or to the existing surface in unpaved areas.
- C. Pipe Zone shall include the full width of trench from the bottom of the pipe or conduit to a horizontal level 12-inches above the top of the pipe. This zone is also part of the “pipe-bedding zone” and as such, unless otherwise shown or specified, it shall be filled with bedding material identical to that which is placed in the bedding zone.
- D. Bedding Zone shall be defined as a layer of material immediately below the pipe zone extending over the full trench width. This is also part of the “pipe-bedding zone”
- E. Pipe-Bedding Zone shall include the zones defined as the “pipe zone” and the “bedding zone”. It shall include the full width of the trench from the bottom of the trench to a point 12-inches above the top of the pipe. Unless otherwise shown or specified, the pipe-bedding zone shall be from 3-inches, or as shown on the Plans, under the pipe to 12-inches over the pipe.
- F. Upper Backfill Zone: The upper backfill zone is defined as the backfill to the full width of the excavation from the top of the structure to the bottom of the pavement zone in paved areas or to the finished surface in unpaved areas.
- G. Structural Backfill Zone: The structural backfill zone is defined as backfill from the top of the structure to the bottom of the excavation, extending the full width of the excavation.

1.05 FIELD CONTROL

- A. Provide the necessary field survey to assure compliance with the lines and grades shown on the Drawings.
- B. Barricades, cones, safety signs, etc. shall be placed and maintained as required by pertinent safety regulations.
- C. Promptly clean up loose excavation dirt and sweep clean all usable portions of roadway and walks as the Work progresses to prevent dirt being scattered. Promptly and regularly apply water or dust palliative to all dust and dirt areas, including stockpiles, to prevent dust from being a nuisance.

1.06 QUALITY ASSURANCE AND TESTING

- A. Where a degree of relative compaction is specified on the Plans or in the Technical Specifications, compaction tests will be made in accordance with the Standard ASTM D 1557,

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- Method C. All densities shall be expressed as a relative compaction in terms of the maximum density obtained in the laboratory by the foregoing standard procedure.
- B. Field density tests shall be performed in accordance with ASTM D 2922, Direct Transmission Method, using the nuclear gauge, or ASTM D 1556, using the sand cone. Backfill materials shall be sampled per ASTM D 75.
- C. "Relative Compaction" shall be expressed as a percentage of the in place dry density to the laboratory maximum dry density.
- D. The Owner will provide lab services to take samples during placement of materials and test for moisture content, density, compaction, gradation, classification, and other required items to ensure conformance with these Specifications.
- E. The Contractor is responsible for coordinating and scheduling all required inspection, sampling, and testing with the Owner provided lab.
- F. While the Owner will pay for compaction tests to verify that the Contractor has met all compaction requirements, the cost of all failing tests due to the Contractor's failure to meet the Specifications shall be paid for by the Contractor. Notify the Owner a minimum of seventy-two (72) hours prior to all inspection, sampling, and testing.
- G. Compaction Testing Intervals and Frequency:
1. All excavations are subject to compaction tests.
 2. The location and frequency of tests shall be at the Owner's discretion.
 3. Testing shall be performed in the presence of the City of Orland representative.
 4. In general, the tests shall be taken as outlined below.
 - a. Testing of Pipelines shall be completed at the following intervals:
 - 1) A minimum of one (1) field density test shall be performed for each backfill lift per 250 linear feet of trench. Where the trench traverses a roadway, a minimum of one (1) field density test shall be performed for each backfill lift per travel lane.
 - b. Testing of Structure Fill, Backfill, and Base.
 - 1) One (1) per lift of fill, per 100 square feet of foundation/slab plan area, or for every 500 cubic yards of completed fill, whichever is more frequent.
- H. The presence of marginal materials or poor soil conditions, as determined by the Owner, or a prevalence of failed test results will be cause for substantially increasing the frequency and reducing the intervals of required testing. Alternatively, with approval of the Owner, the trench zone may be backfilled with a one-sack sand-cement slurry as specified herein at no additional cost to the Owner.
- I. Material placed between successful test and failed test shall be tested at one-fifth (1/5) the distance intervals specified herein until a passing test is achieved. All material from a failed test to

a successful test shall be removed, recompact, and retested by the Contractor per the direction of the Owner at no additional cost to the Owner.

PART 2 MATERIALS

2.01 UNSUITABLE MATERIAL

A. Unsuitable material includes the following:

1. Topsoil containing debris, roots, trees, bushes, and vegetation (minimum of existing top 2 to 4-inches).
2. Soils classified as Pt, OH, OL, MH, and CH under the Unified Soil Classification System (USCS).
3. Material containing more than 3% organic material.
4. Soils which cannot be compacted sufficiently to achieve the density specified for the intended use or soils rejected by the Engineer.
5. Material that contains hazardous or designated waste materials, including petroleum hydrocarbons, pesticides, heavy metals, and any material which may be classified as hazardous or toxic according to applicable regulations.
6. Soils that contain greater concentrations of chloride or sulfite ions, or have soil resistivity or pH less than the existing on-site soils.

2.02 SAND

A. Imported pipe-bedding zone material shall be sand. Sand shall be free from clay or organic material, suitable for the purpose intended, and shall conform to the physical properties listed in the table below. Either gradation is acceptable (REU or PG&E).

<u>Property</u>	<u>Test Method</u>	<u>Specification Requirement</u>	
Organic Impurities	ASTM C40	Supernatant shall not be darker than plate 3 when compared to standard Gardner color series	
Sand Equivalent	ASTM D2149	Equal to or greater than 20	
Compaction Characteristics	ASTM D1557	Relative compaction of 95% or greater	
Gradation	ASTM C136 & ASTM C117	Sieve	Percent Passing (By Weight)
REU		<ul style="list-style-type: none"> • No. 4 (4.75 mm) • No. 8 (2.36 mm) • No. 16 (1.18 mm) • No. 30 (600 um) • No. 50 (300 um) • No. 100 (150 um) 	<ul style="list-style-type: none"> • 100 • 90-100 • 80-100 • 65-100 • 40-70 • 0-30
PG&E		<ul style="list-style-type: none"> • 1/2" • No. 4 • No. 50 • No. 100 • No. 200 	<ul style="list-style-type: none"> • 100 • 75-100 • 0-70 • 0-30 • 0-15

2.03 NATIVE MATERIAL

- A. Native backfill material shall be the material excavated from the Site. The native material used for backfill shall be free of roots and debris, lumps, frozen material, and rocks larger than 3-inches, and which can be compacted to the specified relative compaction.

2.04 ENGINEERED FILL

- A. Engineered fill material suitable for general Site grading, foundation backfill, foundation areas, trench backfill, slab areas, and placement areas is acceptable upon approval. Gradation shall be as specified:

<u>Sieve Size</u>	<u>Percent Passing</u>
4-inch	100
No. 4	25-100
No. 30	10-35
Liquid Limit	30 (max)
Plasticity Index	15 (max)
Max. expansive index	40 (max)

2.05 CRUSHED ROCK BASE

- A. Crushed or natural rock shall be provided as base under the structure shall be in accordance with SSPWC 200-1.2 or Class 2 AB Permeable Material that meets the product requirements provided in Section 68-2.02F(3) of the 2018 Caltrans Standard Specifications. Unless otherwise shown or specified crushed rock shall be 3/4-inch maximum size.
- B. Crushed rock where shown on drawings shall be wrapped in geotextile and compacted to 95 percent relative compaction unless otherwise specified.

2.06 GEOTEXTILE

- A. Geotextile fabric shall be non-woven Mirafi 140NL, or equivalent.
- B. Geotextile shall be placed between the crushed rock base and surrounding natural soil and backfill materials to prevent migration of fines into the crushed rock.
- C. The geotextile shall be overlapped at the top by a minimum of one foot.

2.07 SLURRY CEMENT BACKFILL

- A. Slurry cement backfill, conforming to Section 19-3.02E of the State Standard Specifications, except as modified below, shall consist of a fluid, workable mixture of commercial quality concrete sand, pea gravel, cement, and water. Not less than 188 pounds of cement shall be used for each cubic yard of material produced. Cement shall be Class II/V portland cement conforming to Section 90 of the State Standard Specifications, except that testing will not be required. The final mix design and mix consistency shall be subject to the approval of the Owner.
- A. Slurry Backfill Mix Design per Cubic Yard
 - 1. Pea Gravel: 2,600 lbs.
 - 2. Sand: 800 lbs.

3. Cement: three sacks.
4. Water: 11 gallons.

2.08 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

- A. CLSM shall consist of free-flowing, self-compacting, and machine excavatable material that consists of cement, pozzolan fly ash, fine and coarse aggregates, and water in accordance with Section 19-3.02G of the State Standard Specifications.
- B. Compressive strength at twenty-eight (28) days: Between 50 psi minimum and 100 psi maximum.

2.09 AGGREGATE BASE

- A. Aggregate base shall conform to the requirements of the Technical Specification section titled **“Aggregate Base.”**

2.10 ASPHALT CONCRETE

- A. Asphalt concrete shall conform to the Technical Specification section titled **“Asphalt Concrete Pavement.”**

2.11 CONCRETE

- A. Concrete for concrete collars shall be Class B concrete in accordance with the Technical Specification section titled **“Concrete Work.”**
- B. Concrete for thrust blocks shall be Class C concrete in accordance with the Technical Specification section titled **“Concrete Work.”**
- C. Concrete for pipe cap or encasement shall be Class C concrete in accordance with the Technical Specification section titled **“Concrete Work.”**

PART 3 EXECUTION

3.01 GENERAL

- A. Contractor shall inform the Engineer if any discrepancy between the requirements specified herein, and the geotechnical report identified in Technical Specification titled **“Geotechnical Investigation.”**

3.02 EXCAVATION

- A. General
 1. The Contractor shall excavate whatever substance encountered to the lines and grades shown on the Plans. All material suitable for use as backfill shall be piled in an orderly manner a sufficient distance from the side of the trench to avoid overloading and to prevent sliding into the trench. The Contractor shall do such grading as is necessary to prevent surface water from entering the excavation.
 2. Where it is necessary to cross fences, temporary gates or other barriers, or satisfactory obstructions shall be installed by the Contractor as required to keep livestock and/or household pets from entering or leaving the property. All cut fences shall be restored to original condition upon completion of backfilling of the trench.

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3. During excavation, excavated material shall be stored only within the working area. Roadways or streets shall not be obstructed. The safe loading of trenches with excavated material shall conform to federal, State, and local laws.
4. Explosives shall not be used for excavation.
5. The Contractor shall obtain the Engineer's written approval of completed subgrades prior to:
 - a. Scarification of foundation subgrade.
 - b. Placing Engineered Fill.
 - c. Placing geotextile fabric.
 - d. Placing Structural Fill AB Material over geotextile.
 - e. Forming the foundation, slab, or footing over compacted Engineered Fill Material encapsulated in geotextile fabric.

B. Pipe Trench

1. Except with the specific approval of the Engineer, no more than 200 feet of open trench shall be excavated in advance of laying the pipe. Not more than 50 feet of trench excavation shall remain exposed (i.e. not backfilled) at the end of each day's work. The remainder of the trench shall be backfilled, compacted, and opened to traffic. All operations shall be carried out in an orderly fashion. Backfilling, compacting, and cleanup work shall be accomplished as sections of the pipe installation are approved and traffic through the Work shall be impeded or obstructed as little as possible.
2. Where trenches cross city streets, backfilling shall be completed immediately following excavation. No trenches across streets shall remain open overnight. All crossings shall be backfilled, compacted, and open to traffic at the end of each day's work. Major road crossings shall be excavated and backfilled in half widths of the traveled way so that at least one-half of the roadway is open to controlled traffic at all times during the Work.
3. Where it is necessary to cross irrigation or drainage ditches, the backfill in the bottom and banks of such ditches shall be carefully placed and compacted to avoid settlement. Shape of the banks and bottom shall be restored and left in good condition.

C. Trench Width

1. Except where otherwise specifically permitted, banks of trenches shall be vertical, and shall be of uniform width from top to bottom. Trenches shall be a minimum of 8 inches wider than the external diameter of the pipe or the pipe manufacturer's recommended minimum, whichever is greater. The maximum width of the trench, measured at the top of the pipe, shall not exceed the width allowed for various strengths of pipe as may be specified elsewhere in the applicable sections of these Standard Specifications.
2. If a maximum width is not specified, the width measured at the top of the pipe shall not exceed the external diameter of the pipe, exclusive of bells and collars, plus 24 inches.

D. Stripping of Top Soil

1. Where the trench crosses cultivated, residential, or meadow land not in a roadway, the top 12 inches of soil shall be stripped and stockpiled separately from the balance of the excavated material so that later it may be placed in the top of the trench backfill.

E. Bracing of Trench

1. Where required to prevent caving of the trench, the Contractor shall furnish and install bracing and sheeting as necessary to protect the excavation and to meet safety regulations. If required by the Owner, the Contractor shall install sheeting and bracing as required to permit the City of Orland Representative safe access to the trench for inspection of the Work. However, this requirement does not relieve the Contractor of the responsibility for maintaining the trench to meet safety regulations.

F. Depth of Trench

1. The bottom of the trench shall be carried to the lines and grades shown on the Plans with proper allowance for the thickness of the pipe and for the type of bedding specified. Any part of the trench excavated below the proper grade shall be corrected with Owner approved bedding material at the Contractor's expense. Relative compaction shall be not less than 95 percent.

3.03 DEWATERING

- A. Suitable means and devices shall be provided and maintained to continuously remove and dispose of all water entering the trench excavation during the time the trench is being prepared for the pipe laying, during the laying of the pipe, and until the backfill at the pipe zone has been completed. Water shall be disposed of in a legal manner to prevent damage to adjacent property. Trench water shall not be drained through the pipeline under construction. Groundwater shall not be allowed to rise around the pipe until jointing compound has firmly set.
- B. The Contractor shall remove and dispose of all water entering the excavation. Disposal of water shall be done in a manner to prevent damage or nuisance to adjacent properties. Water removed from the excavation shall not be disposed of in storm drainage facilities.
- C. Straw waddles, gravel bags, sediment traps, or other devices shall be provided to prevent silt and sediment from entering storm drainage facilities. Placement and maintenance of devices shall be in accordance with the Plans, any Storm Water Pollution Prevention Plan (SWPPP) developed for the Project, and as directed by the Owner.
- D. Sufficient pumping equipment shall be provided to maintain the trench in a dry condition during the bedding and initial backfilling of the pipe.

3.04 TYPES OF FILL MATERIALS

- A. Unless otherwise shown or specified on the Drawings, fill materials are as follows:
- B. Pavement Zone
 1. Aggregate Base shall conform to the Technical Specification section titled "**Aggregate Base.**"
 2. Asphalt concrete shall conform to the Technical Specification section titled "**Asphalt Concrete Pavement.**"

- C. Trench Zone
 - 1. Imported Sand specified herein.
 - 2. Suitable Native Materials specified herein.
 - 3. Suitable Engineered Fill specified herein.
- D. Pipe Bedding Zone
 - 1. Native materials shall not be used in the pipe-bedding zone.
 - 2. Imported Sand material specified herein.
- E. Subgrade
 - 1. Suitable Engineered Fill specified herein.
- F. Over-Excavation
 - 1. Suitable Engineered Fill specified herein.
 - 2. Aggregate Base shall conform to the Technical Specification section titled “**Aggregate Base.**”
- G. Structural Zone
 - 1. Suitable Engineered Fill specified herein.
 - 2. Unless otherwise shown or specified, Contractor shall install compacted crushed rock base for structures a minimum of 6 inches thick and extend 1 foot from the structure in all directions as shown on the Drawings.
- H. Upper Backfill Zone
 - 1. Suitable Native Materials specified herein.
 - 2. Suitable Engineered Fill specified herein.
- I. Ground Cover
 - 1. Crushed Rock Base as specified herein.

3.05 COMPACTION REQUIREMENTS

- A. Unless otherwise shown or specified on the Drawings compaction requirements per ASTM D 1557 are as follows:
- B. Backfill in Pavement Zone
 - 1. 95 percent relative compaction.
- C. Trench Zone
 - 1. 95 percent relative compaction within 3 feet from ground surface.
 - 2. 90 percent relative compaction greater than 3 feet from ground surface.
- D. Pipe-Bedding Zone

- 1. 90 percent relative compaction.
- E. Subgrade
 - 1. 95 percent relative compaction.
- F. Over-Excavation
 - 1. 95 percent relative compaction.
- G. Structural Zone
 - 1. 95 percent relative compaction.
- H. Upper Backfill Zone
 - 1. 95 percent relative compaction.
- I. Ground Cover
 - 1. 95 percent relative compaction.

3.06 OVER-EXCAVATION

- A. Pipeline Trench
 - 1. After the required excavation has been completed, the City of Orland Representative shall inspect the exposed trench subgrade to determine the need for any additional excavation. It is the intent that additional excavation shall be conducted in all areas within the influence of the pipeline where unacceptable materials exist at the exposed subgrade.
 - 2. Over-excavation shall include the removal of all such unacceptable material that exists directly beneath the pipe base and to the depth required. The presence of unacceptable material may require excavating a wider trench. The width and depth of known areas to be over-excavated shall be shown on the Drawings.
 - 3. The over-excavated portion of the trench shall be backfilled to the subgrade of the pipe base with Engineered Fill, or aggregate base for foundation stabilization. Foundation stabilization material shall be placed over the full width of the excavation and compacted in layers not exceeding 6 inches in depth to the required grade.
- B. Water Tank Pad
 - 1. Required over excavation to depth of 15 feet below grade, or 12 feet below the bottom of the foundation, whichever is deeper and replaced with engineered fill.
- C. Proposed Booster Pump Building and Generator Pad
 - 1. Required over-excavation 2 feet below the bottom of the foundation and 3 feet horizontally beyond the foundation to be replaced with engineered fill.
- D. Structure (Other)
 - 1. All exterior concrete flatwork to be supported on 12 inches of engineered fill.

3.07 SUBGRADE PREPARATION

- A. Subgrade that will receive engineered fill, or to be left at existing grade, or represent the final subgrade in soil achieved by excavation shall be scarified 8 inches minimum and recompacted to 95 percent relative compaction (ASTM D 1557).
 - 1. Suitability of soils exposed at the bottom of all subgrades shall be verified by the City of Orland representative.

3.08 APPURTENANCES

- A. Excavations for valve vaults and other similar structures shall be large enough to provide proper working room. Any over-depth in excavation shall be corrected with concrete or other approved material.

3.09 CONCRETE ENCASEMENT

- A. Concrete encasement shall be installed at the locations and in the manner shown on the Plans. The pipe shall be temporarily supported on masonry blocks. Supports shall be set accurately to grade with a minimum of two supports per joint of pipe. After the pipe has been laid and approved for covering, the pipe shall be bedded and encased in concrete as detailed on the Plans. Great care shall be taken not to float or shift the pipe during the concreting operation.

3.10 CONCRETE CAP

- A. Concrete caps shall be installed at the locations and in the manner shown on the Plans. The pipe shall be supported on compacted backfill as shown. After the pipe has been laid and approved for covering, the pipe shall be capped with concrete as detailed on the Plans. Great care shall be taken not to shift the pipe during the concreting operation.

3.11 BACKFILL - GENERAL

- A. Prior to commencing backfilling operations, the Contractor shall notify the Owner of the proposed method of compaction. No compaction method will be approved until the Contractor has demonstrated, under actual field conditions, that such method will produce the degree of compaction required.
- B. No backfilling shall be done until the installation to be covered has been inspected and approved by the City of Orland Representative for covering. Backfilling shall be carried out in an orderly fashion and, in general, shall be done as soon as approval has been given to cover the pipe. Compaction of the backfill shall proceed simultaneously with backfilling operations.
- C. Suitable native or imported materials can be used for backfill. The excavation shall be backfilled in layers with suitable imported material which may be placed by machine. Material shall be placed in 8-inch thick (uncompacted) layers and compacted by machine.
- D. Fill shall be placed and compacted in horizontal lifts, using equipment and procedures that will produce the recommended moisture contents and densities throughout the lift.
- E. All excess backfill material shall be removed from within the Project limits and disposed of by the Contractor. The location of the disposal site shall be the responsibility of the Contractor. Removal of excess material shall be done immediately following backfilling.

- F. Where trenches cross city streets, backfilling shall be completed immediately following excavation. No trenches across streets shall remain open overnight. All crossings shall be backfilled, compacted, and open to traffic at the end of each day's work. Major road crossings shall be excavated and backfilled in half widths of the traveled way so that at least one-half of the roadway is open to controlled traffic at all times during the Work.

3.12 BACKFILL – PIPE BEDDING ZONE

- A. The bed for the pipe shall be final-graded by hand to the lines, grades, and slopes to which the pipe is to be laid, making proper allowance for the thickness of the pipe. The bed shall be hand-raked ahead of the pipe laying operation to remove any stones or lumps which will interfere with smooth and proper bedding. Bell holes shall be hand-dug at the location of the joints and shall be of sufficient size to allow proper making of the joint and to prevent the collar or bell of the pipe from bearing on the bottom of the trench.
- B. After the pipe has been laid and approved for covering, backfill shall be placed evenly on both sides of the pipe the full width of the trench. This material shall be placed by hand in layers and compacted by use of approved tampers.
- C. For pipe 10 inches in nominal diameter or less, the first layer shall be half the outside diameter in thickness and shall be tamped by hand. The thickness of the next layer shall be half of the diameter of the pipe plus 12 inches.
- D. For pipe 12 inches and larger in nominal diameter, the backfill material shall be placed in layers not more than 8 inches thick.
- E. Particular care shall be taken to attain the required compaction in the material supporting the underside of the pipe. Compaction by jetting or ponding shall not be permitted.

3.13 BACKFILL – TRENCH ZONE

- A. Backfill and compaction onsite and within private driveways and public roads shall be done in accordance with the terms of the *Public Works Improvement Standards*. The following requirements are minimums and do not relieve the Contractor of the responsibility of complying with any more stringent requirements of the *Public Works Improvement Standards*.
- B. Suitable native or imported materials can be used for backfill. The trench shall be backfilled in layers with suitable imported material which may be placed by machine. Material shall be placed in 6 inch thick layers and compacted by machine.
- C. Immediately after backfilling, all excess material shall be removed and disposed of in an approved disposal area.

3.14 BACKFILL WITHIN CITY AND COUNTY STREETS AND PRIVATE DRIVEWAY AND ROADS

- A. In public roads, backfill and compaction shall be done as shown. The following requirements are minimums and do not relieve the Contractor of the responsibility of complying with any more stringent requirements of the City of Orland Standards.
- B. The trench zone shall be backfilled in layers with suitable native or imported materials which may be placed by machine. Material shall be placed in 6 inch thick layers and compacted by machine.

3.15 MATERIAL REPLACEMENT

- A. Backfill material, which does not meet the Specifications, shall be removed, disposed of, and replaced with Engineer approved material at no additional expense to the Owner.

3.16 SLURRY CEMENT BACKFILL

- A. Where shown on the Plans, and at locations approved by the Owner, the trench shall be backfilled with slurry cement from the top of the pipe bedding envelope to the bottom of the trench resurfacing structural section.
- B. Immediately after backfilling, all excess material shall be removed and disposed of in an Engineer approved disposal area.

3.17 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

- A. Place CLSM in accordance with Section 19-3.03I of the State Standard Specifications.

3.18 PROTECTION OF PAVING

- A. During the entire construction period, the Contractor shall protect existing pavement. Track-laying equipment shall be equipped with pavement pads when used on pavement. Any pavement damaged, cracked, or broken by the Contractor's operation shall be removed and replaced to at least the original condition. Damaged pavement shall be restored to the satisfaction of the Owner.

3.19 REMOVAL AND REPLACEMENT OF PAVING AND BASE

- A. Only such paving and base shall be removed as is necessary to excavate the trench and install the pipe in accordance with requirements listed in Technical Specification section titled "**Asphalt Concrete Pavement.**" Cuts at valve vaults shall be no larger than necessary to install the structure.
- B. Replacement of Paving
 - 1. Paving shall be replaced in accordance with the Specifications, the City Improvement Standards, the County Improvement Standards, and the details shown on the Plans. Pavement shall be replaced in all streets and highways as soon as possible after completion of backfilling. In no case shall any section of trench in public roads remain unpaved more than one week from the date that the excavation was made. Where trenches cross roadways, pavement shall be replaced the same day the excavation was made.
- C. Temporary Pavement
 - 1. Where weather conditions or time preclude placing permanent pavement, temporary pavement will be installed. Temporary paving will consist of a one-inch-thick layer of premixed asphaltic surfacing material and shall be installed flush with the existing surface. Temporary pavement shall be maintained in a smooth and uniform condition, and shall be completely removed prior to placing permanent pavement.
- D. Placing Aggregate Base
 - 1. Where base material is required, the aggregate base shall be placed and compacted in one even layer to the depth shown on the Plans, and extending the full width of the

trench, in accordance with requirements listed in the Technical Specification section titled **“Aggregate Base.”** Segregation shall be avoided and extra care shall be taken in compacting the base near the sides of the trench. Relative compaction shall be not less than 95 percent.

E. Preparation for Asphalt Concrete Paving

1. Edges of existing paving shall be neatly cut along straight lines and the cut edges shall be vertical in accordance with requirements listed in the Technical Specification section titled **“Asphalt Concrete Pavement.”** All loose pieces or cracked sections of existing paving shall be removed. All vertical edges shall be coated with liquid asphalt-emulsion.

F. Installing Asphalt Concrete

1. Asphalt concrete shall be placed to the thickness shown on the Plans or to match existing, whichever is greater, in accordance with requirements listed in the Technical Specification section titled **“Asphalt Concrete Pavement.”**

3.20 GRADING

- A. After other outside Work has been finished, and backfilling and fills completed and settled, all areas which are to be graded shall be brought to grade at the indicated elevations, slopes, and contours. All cuts, fills, and other areas which have been disturbed or damaged by construction operations shall be brought back to original grade.
- B. Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to manual methods. All surfaces shall be graded to secure effective drainage. Unless otherwise indicated, a slope of at least two (2) percent shall be provided.
- C. Soil ground surface shall be sloped at minimum 5 percent (2 percent for pavement) down and away from all structures at least 10 feet beyond the perimeter of the structure of placement. Any discrepancy in grading on the Plans shall be immediately notified to the Engineer.
- D. Final grades and surfaces shall be smooth, even, and free from clods and stones, weeds, brush, and other debris.
- E. Cut and Fill Slopes
 1. Soil shall be graded at an inclination of 2 horizontal to 1 vertical (2H : 1V) or Flatter.

3.21 SETTLEMENT

- A. The Contractor shall be responsible for all settlement of backfill which may occur within the correction period stipulated in General Conditions.
- B. The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from the Owner.
- C. The Contractor shall guarantee the Work against settlement for a period of one (1) year.

3.22 SITE GROUND COVER

- A. Place gravel/crushed rock surfacing for the water tank site as shown. Finish grade of the rock shall be as shown on the Drawings.
- B. The gravel rock ground cover shall be installed at the completion of construction so as not to be contaminated during the construction process. The Contractor shall be responsible for fine grading and clean-up of the Site prior to gravel rock placement.

3.23 CLEAN UP

- A. The Contractor shall clean up and dispose of all trash, debris, and excess material, and shall remove their equipment from the Site of the Work as completed.



PART 1 GENERAL

1.01 SCOPE

- A. This section covers potable water pipe, fittings, and appurtenances.

1.02 SUBMITTALS

- A. Submittals shall be furnished in accordance with the Technical Specification section titled **“Submittals.”**

B. Steel Pipe

1. Prior to the fabrication of any pipe materials specified under this section of the Specifications, the Contractor shall submit line layout drawings and detailed shop drawings. Include lay lengths of fittings, valves, meters, couplings, harnesses, and other equipment which determine piping dimensions. Label or number each fitting or piece of pipe and provide the following information for each item:
 - a. Materials of construction, including references to industry standards being met (i.e. ASTM, ANSI, AWWA, and other related standards).
 - b. Shop inspection and testing requirements.
 - c. Inside diameter, steel wall thickness, internal design pressure (lining and coating thicknesses) for each class of pipe to be furnished.
 - d. Electrode manufacturer’s data and product data, including electrodes to be used for dissimilar metals.
 - e. Indicate all shop and erection details including cuts, copes, connections, holes, threaded fasteners, and welds. Indicate welds using AWS “Welding Symbols.”
 - f. Order of installation and closure locations for length adjustment and for construction convenience.
 - g. Pipe invert station and elevation of each change of grade and alignment.
 - h. Elements of curves and bends, both in horizontal and vertical alignment, including elements of the resultant true angular deflections in cases of combined curvature.
 - i. Paint primer type and thickness where joints and other coating and lining holdbacks occur.
 - j. Call out types, sizes, dimensions of grooved-end collars, flanges, reinforcing collars, wrapper plates, and crotch plates.
 - k. Limits of each reach of field-welded joints and of concrete encasement.
 - l. Locations of manholes and other points of access.

- m. Location of valves and other mechanical equipment.
- n. Locations of bulkheads for field hydrostatic testing of pipeline.
- 2. All shop drawings of pipe fittings, specials, and ends shall be reviewed and stamped by the pipe manufacturer before submittal to the Owner.
- 3. Show all pertinent details for field installation and shop fabrication of pipe, pipe fittings and specials for piping, including joint details for approval by the Owner.
- 4. Pipe, pipe fittings and specials, and joints shall be fabricated in accordance with the approved shop drawings. No deviations will be allowed.
- 5. Mill test reports on each heat from which steel is rolled.
- 6. Welding
 - a. Welder performance qualification test records “welders’ certification.”
 - b. Written Welding Procedure Specifications (WPSs) in accordance with AWS D1.1 requirement for each different welded joint proposed for use whether prequalified or qualified by testing.
 - c. Welding Procedure Qualification Records (WPQR) test results.
 - d. Welding repair procedures.
 - e. Certified Material and Test Reports.
 - f. Schedule detailing inspections, NDT test dates and inspection hold points.
 - g. Inspection and Testing (physical and chemical properties of all steel, hydrostatic test reports, weld test reports, etc.).
- C. PVC Pipe
 - 1. Affidavits of compliance with standards referenced in this Specification (AWWA C900, etc.) shall be provided.
 - 2. Submit materials list and manufacturer’s specification sheets showing material of pipe, fittings, joint restraint, and appurtenances with ASTM reference and grade.
 - 3. Joint details for all types of joints used shall be submitted.
 - 4. If required by the Owner, calculations and/or test data proving that each proposed restrained joint arrangement can transmit the required forces shall be submitted.
- D. Ductile Iron Pipe
 - 1. Ductile Iron Pipe submittals for potable water mains shall include a minimum as required in the Technical Specification section titled “**Ductile Iron Piping.**”
- E. Galvanized Steel Pipe

02512 - WATER PIPE AND FITTINGS

1. Submit materials list showing material of pipe and fittings with ASTM reference and grade.
 2. Submit lining, coating, and thicknesses.
- F. Copper Pipe
1. Submit materials list and manufacturer's specification sheets showing material of pipe, fittings, proposed method of joint restraint, and appurtenances with ASTM reference and grade.
 2. Submit catalogue order sheets for materials of pipe, fittings, solder, and appurtenances, showing metal composition and conformance to industry standards (ASTM, etc.) specified. The material data sheets shall indicate NSF certification for materials used on the potable water system.
- G. Polyethylene Pipe
1. Affidavits of compliance with standards referenced in this Specification (AWWA C901, etc.) shall be provided.
 2. Submit materials list and manufacturer's specification sheets showing material of pipe, fittings, and appurtenances with ASTM reference and grade.
- H. Couplings
1. Submit manufacturer's catalog data and detail construction sheets showing all parts, dimensions, linings, coatings, and describing materials of construction by material and specification (such as AISI, ASTM, SAE, or CDA).
- I. Submit manufacturer's catalog data, detail construction sheets, materials of construction by material and specification for gaskets, insulation kits, hardware, and polyethylene encasement.
- J. Connections to existing systems
1. Submit existing system connection details and materials.
 2. Submit proposed existing system connection and materials/equipment inspection dates.
- K. Submit a comprehensive hydrostatic testing plan and a test report for each section. Include test bulkhead locations and design calculations, pipe attachment details, and methods to prevent excessive pipe wall stresses.

1.03 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Materials used in the manufacture of the pipe shall be tested in accordance with the requirements of this Section and the referenced standards, as applicable.
- C. The Contractor shall perform said material tests. The Engineer shall have the right to witness testing, provided that the Contractor's schedule is not delayed for convenience of the Engineer.

- D. In addition to those tests specifically required, the Engineer may request additional samples of any material for testing by the City. The additional samples shall be furnished as part of the Work.
- E. The City of Orland Representative will be responsible for field welding inspection (visual), as noted elsewhere in this section. The Contractor is responsible for scheduling inspection with the Engineer at least 72-hours prior all field welding work.

1.04 WELD INSPECTION AND TESTING

- A. If required, the City will provide Special Inspection, defined by California Building Code (CBC) Section 1704, for welding.
- B. Visual welding inspection and Non-Destructive Testing (NDT) shall be conducted in accordance with a written practice by personnel qualified in accordance with AWWA C206.
- C. Weld Tests
 - 1. Visual Inspection
 - a. Continuous visual inspection.
 - b. Check fit-up of joint materials. Verify satisfactory alignment of material. Verify gaps and bevels of penetration welds.
 - c. Check during welding. Verify satisfactory technique is used.
 - d. Check after welding completed and cleaned by wire brush or chipping hammer.
 - e. Inspect with magnification when necessary and under strong, adequate light.
 - f. Inspect for the following defects:
 - 1) Surface cracking.
 - 2) Porosity.
 - 3) Excessive roughness.
 - 4) Unfilled craters.
 - 5) Gas pockets.
 - 6) Undercuts.
 - 7) Overlaps.
 - 8) Size.
 - 9) Insufficient throat and concavity.
 - 2. Nondestructive Testing

- a. Ultrasonic testing, except where not feasible, as determined by the Owner, due to the type or location of the weld. Magnetic particle, liquid penetrant, or radiograph tests when ultrasonic testing is not feasible as determined by the Owner.
 - 1) Ultrasonic inspection technique and standards: AWS D1.1 Part C.
 - 2) Particle inspection method: ASTM E 709.
 - 3) Penetrant inspection method: ASTM E 165.
 - 4) Radiography tests: AWS D1.1, Part B.
 - 5) Nondestructive testing technicians and operators shall be NDT Level II as defined in American Society for Nondestructive Testing, Inc., Recommended Practice No. SNT-TC-1A. The Level II technician shall sign the test reports.
- 3. Shop Inspection and Testing
 - a. Visual inspection of all welds.
 - b. Measurement of weld profiles for 25 percent of all welds at random.
 - c. NDT for all welds.
- 4. Field Inspection
 - a. Visual inspection of all welds.
 - b. Measurement of all weld profiles [for 25 percent of all welds at random].
 - c. NDT for a 25 percent of all field welds.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Pipe, fittings, specials, couplings, joint restraints, and appurtenances shall at all times be handled and stored in a manner that will ensure installation in sound, undamaged condition.
- B. Onsite Storage Limitation: Onsite pipe storage shall be limited to a maximum of one week unless exception is approved by the Owner.
- C. Care shall be taken to avoid cracking of the cement mortar coating and/or lining on steel or ductile iron pipe and fittings. If necessary, plastic sheet caps shall be used to close pipe ends and keep coatings and linings moist.

PART 2 MATERIALS

2.01 GENERAL

- A. All materials and lubricants shall be NSF 61 certified for potable water applications.

2.02 STEEL PIPE AND FITTINGS

A. Steel Pipe

1. Steel pipe shall be mill-type steel pipe in accordance with AWWA C200 rated for a working pressure of 150 psi, but the steel cylinder thickness shall be a minimum 1/4-inch. Steel shall be ASTM A 36, ASTM A 1011 or A 1018, Grade 36, having a 0.25% maximum carbon content.

B. Fittings

1. Definition: A fitting shall be defined as a piece of pipe other than a straight full-length joint. Elbows, manhole sections, reducers, and sections of pipe with outlets shall be considered fittings. Dimensions shall be per AWWA C208.
2. Pressure Rating: Fittings 4- through 10-inches in diameter shall be designed for 250 psi and conform to ANSI B16.9. Fittings 12-inches in diameter and larger shall comply with AWWA C208.
3. Fittings: Fittings shall be flanged, butt-welded, or grooved as shown. Material for fittings 4- through 10-inches shall comply with ASTM A 234, Grade WPB. Material for fittings larger than 10-inches but less than or equal to 30-inches in diameter shall be the same as the pipe. Wall thickness (except for grooved ends) shall be the same as the adjoining pipe. Grooved-end joints shall comply with AWWA C606. Cement-mortar lining and I.D. dimensions shall be the same as the specified pipe. Smooth long radius forged steel fittings are required in-lieu of fabricated steel fittings.
4. Design: Collars, wrapper plates, crotch plates, and other fittings shall be designed in accordance with AWWA M11.

C. Length of Pipe Sections

1. Pipe sections shall be limited to 40 feet or less. For sections longer than 30 feet, spreader beams and lifting straps shall be used to lift pipe sections at the third points.

D. Joints

1. Above Ground Joints: Joints above ground or in vaults and structures shall be flanged or grooved end, unless specifically indicated otherwise on the Project plans.
2. Buried Joints
 - a. Bell-and-spigot lap welded unless specifically indicated otherwise on the Project plans.
 - b. Butt-strap joints. Closure pieces may also require butt-strap joints with "hand-holes" and threaded-steel plugs welded into place (for proper repair of the lining of the interior pipe joints).
3. Grooved-End Joints: Grooved-end joints shall be flexible, square-cut grooved, per AWWA C606, Table 5.

E. Coating and Lining

1. Pipe and fittings installed above ground and below ground shall be fusion bonded epoxy lined and coated in accordance with AWWA C213 in accordance with the Technical Specification section titled "**Protective Coating**".
- F. Flanges shall be AWWA C207, Class D, flat face.
- G. Outlets
1. Outlets 2-inches in Diameter and Smaller: Outlets of sizes 2-inches in diameter and smaller shall be of the "Thread-o-let" type, per AWWA Manual M-11. Outlets shall be 3,000-pound WOG forged steel per ASTM A105 or ASTM A216, Grade WCB. Threads shall comply with ASNI B2.1. Outlets shall be Bonney Forge Co. "Thread-o-let", Allied Piping Products Co. "Branch-let", or approved equal.
 2. Outlets Larger than 2-inches in Diameter: For outlets larger than 2-inches in diameter, flanged tees shall be used.
- H. Grooved-end couplings
1. Grooved-end couplings shall be ductile iron, ASTM A536, Grade 65-45-12 or greater. Gaskets shall be EPDM and shall conform to ASTM D2000. Couplings shall be flexible type, square cut groove, per AWWA C606. Couplings for steel pipe 24-inches in diameter and smaller shall be flexible type, square cut groove, per AWWA C606, and shall be Victaulic Style 77.

2.03 DUCTILE IRON PIPE AND FITTINGS

- A. Ductile Iron Pipe and fittings shall be in accordance with the Technical Specification section titled "**Ductile Iron Piping.**"

2.04 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

- A. PVC pipe 3 inches and smaller shall be SR (Schedule Rated) in accordance with ASTM D1785 for Schedule 80 pipe and suitable for solvent weld joints. Fittings shall be Schedule 80 socket fittings conforming to ASTM D2467.
- B. PVC Pipe 4 inches and larger shall comply with AWWA C900. Unless otherwise shown, the dimension ratio (DR) for 4 inch through 12 inch shall be DR 18 or thicker walled (lower DR). Fittings shall be ductile-iron conforming to the requirements specified herein with the same pressure rating and hydrostatic test pressure as the adjoining pipe.
- C. C900 PVC pipe shall be as manufactured by Diamond Plastics Corporation, JM Eagle, NAPCO, or approved equal.

2.05 GALVANIZED STEEL PIPE AND FITTINGS, 3-INCHES IN DIAMETER AND LESS

- A. Galvanized steel pipe shall be, hot-dip galvanized, standard weight (Schedule 40) conforming to ASTM A53.
- B. Fittings shall be threaded forged steel fittings conforming to ASTM A105, ASME B1.20.1, and ASME B16.11 and galvanized conforming to ASTM B633.

2.06 RESTRAINED JOINTS FOR C900 PVC PIPE

- A. Where restrained joints are required (specified or shown on the Drawings), the system shall be suitable for mechanical joint fittings, bell and spigot joints, or flanged fittings as needed. The tee-bolts, threaded rods, and associated hardware shall be 316 stainless steel. Restraints shall be fusion-bonded epoxy lined and coated in accordance with the Technical Specification section titled “**Protective Coating.**”.
1. Mechanical joint restraint system shall be one of the following or equal:
 - a. EBAA Iron Series 2000PV MEGALUG.
 - b. Star Pipe PVC Stargrip Series 4000.
 2. Bell and spigot restraint system shall be one of the following or equal:
 - a. EBAA Iron Series 2800.
 - b. Star Pipe PVC Stargrip Series 4400.
 3. Flanged joint to plain end pipe restraint system shall be one of the following or equal:
 - a. Steel Flange: Baker Series 602.
 - b. Ductile Iron Flange: ROMAC Style RFCA-PVC.

2.07 COPPER PIPE

- A. Copper pipe and tubing shall conform to ASTM B88. Copper pipe and tubing shall be cylindrical, of uniform wall thickness, and shall be free from any cracks, seams, or other defects. Piping buried or located beneath floor slabs shall be Type K.
- B. Copper fittings shall be copper conforming to ASTM B75 and ANSI B16.22, with solder end joints. Copper fittings 3/8-inch and smaller may have flared end connections or compression joint connections. Solder shall be tin-silver solder conforming to ASTM B32, Grade Sn94, Sn95 or Sn96. Cored solder shall not be used. Solder and flux used in joints of potable waterlines shall contain no more than 0.2 percent lead.
- C. Copper pipe shall be as manufactured by Cambridge-Lee Industries, Inc., Cerro Copper Products Company, Halstead Industries, Inc., IUSA/Reading, Mueller Manufacturing Entities c/o Mueller Industries, Inc., or approved equal.

2.08 POLYETHYLENE PIPE

- A. Pipe
1. Polyethylene pipe shall be PE 4710, SDR9, with blue color-coded stripe conforming to AWWA C901 and ANSI/NSF Standard 61. For potable water applications, PE4710 compound shall conform to ASTM D3350 minimum Cell classification PE445574C-CC3.
 2. Color identification by the use of stripes: equally spaced, blue color stripes co-extruded into the pipe outside surface. Stripes printed on the pipe outside surface are not acceptable.

3. Polyethylene piping is allowed for water services. Water service piping from water main to meter shall be one continuous length and shall not have any joints.
- B. Polyethylene pipe shall be as manufactured by Performance Pipe (a division of Chevron Philips Chemical Company), JM Eagle, or approved equal.

2.09 FLEXIBLE COUPLINGS

- A. Flexible couplings shall be as manufactured by Rockwell, Baker, Romac or approved equal. All mechanical couplings shall have the longest standard sleeve length and shall be provided with thrust anchors. Coupling material shall match the connecting valve, fitting, or pipe material. Couplings shall have Type 316 stainless steel hardware and be fusion-bonded epoxy lined and coated in accordance with the Technical Specification section titled "**Protective Coating.**"

2.10 CONCRETE

- A. Concrete for thrust blocks shall be Class C concrete and shall conform to the Technical Specification section titled "**Concrete Work.**"

2.11 POLYETHYLENE ENCASEMENT

- A. Unless specified otherwise, all buried ferrous pipe, fittings (all material types), couplings, flanges, and valves shall be polyethylene encased in accordance with ANSI/AWWA C105. Polyethylene wrap shall be loose 8-mil thick LLD or 4-mil thick HDCL polyethylene tube. Polyethylene adhesive tape shall be two inch-wide and 10-mil thick, Polyken 900, Scotchwrap 50, or approved equal.

2.12 TRACER WIRE

- A. Tracer wire material shall be in accordance with the Technical Specification section titled "**Facility Identification.**"

2.13 FLANGE INSULATION KIT

- A. Material shall be designated by the manufacturer as suitable for the operating temperature and pressure of the service. Flange insulation kits shall consist of the following items:

1. Insulating Gaskets
 - a. Gaskets shall be Type E full-faced, 1/8-inch minimum thickness, dielectric neoprene faced phenolic. Gaskets shall be Advance Products & Systems, Inc.; George Fischer Central Plastics; Pipeline Seal & Insulator, Inc; or equal.
2. Insulating Sleeves and Washers
 - a. Insulating stud sleeves and washers shall be one-piece and full-length, made of Minlon or Mylar. One 1/8-inch-thick gasket shall be attached to the sleeve, while the other shall be loose. Single insulating washers and sleeves shall be used on buried insulating flanges.
3. Insulating Washers for Bolts
 - a. Insulating washers shall be 1/8-inch thick glassclad phenolic. Single insulating washers shall be used on buried insulating flanges. Double insulating washers

and full-length sleeves shall be used on insulating flanges above ground, in structures, or in vaults.

4. Steel Washers Over Insulating Washer
 - a. Steel backing washers shall be 1/8-inch-thick Type 316 stainless steel.
5. Compatibility with Valves
 - a. Insulating flange kits are not compatible with most valve flanges. Where cathodic isolation is required near a valve, a flanged spool shall be installed adjacent to the valve, and the required insulating joint shall be installed at the opposite end of the spool from the valve. Flanged spool material shall match valve material.
6. Manufacturers
 - a. Flange insulation kits shall be as manufactured by Advance Products & Systems, Inc.; George Fischer Central Plastics; Pipe Seal & Insulators; or equal.

2.14 BOLTS, NUTS, AND WASHERS FOR FLANGES

- A. Bolts, nuts, and washers for flanges shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M, for bolts and ASTM A 194, Grade 8M, for nuts.
- B. For grooved-end fittings, bolts shall be Type 316 stainless steel and conform to ASTM F 593 or ASTM A 183 and have a minimum tensile strength of 100,000 psi.
- C. Washers shall be provided for each nut, shall be of the same material as the nut, and shall be installed adjacent to the nut, between the nut and the flange.
- D. The length of each bolt shall be such that between 1/4-inch and 1/2-inch will project through the nut when drawn tight. Studs may be used instead of bolts only where approved by the Engineer.

2.15 GASKETS

- A. Gaskets for Flanged Joints: Gaskets for flanged joints shall be 1/8-inch thick and be made of EPDM, or synthetic fiber. Gaskets shall be suitable for a water pressure of 350 psi at a minimum temperature of 180°F. Gaskets shall be NSF 61 certified for potable water applications. Full face type gaskets with pre-punched holes shall be used where both flanges are flat face. Ring gaskets extending to the inner edge of the bolts may be used where a raised face flange is present.
- B. Gaskets for Push-on, Mechanical, and Restrained Joints: Gaskets for push-on, mechanical, and restrained joints shall be synthetic or natural rubber in accordance with AWWA C111.
- C. Manufacturers: Gaskets shall be Garlock 3760-U and 98206, Teadit Style 1082 SAN, and U.S. Pipe Flange-Tyte, or equal.

2.16 THREAD LUBRICANT

- A. Thread lubricant for threaded joints shall be Teflon thread lubricating compound or Teflon tape.

PART 3 EXECUTION

3.01 GENERAL

- A. All materials shall be handled in a manner that will not damage the material or its coating. Before installation, each article shall be inspected, and any damaged material shall be discarded. Any damaged coating shall be repaired. The interior and ends of the pipe and appurtenances shall be clean. When it is necessary to cut pipe, such cuts shall be neatly made with equipment recommended by the pipe manufacturer.
- B. Water lines shall be installed at least ten (10) feet, measured horizontally, from existing or proposed sewer lines, or force mains unless shown otherwise.
- C. Water lines shall be installed at least four (4) feet, measured horizontally, from existing or proposed storm drains, or disinfected tertiary recycled water unless shown otherwise.
- D. Water lines shall be installed a minimum of three (3) feet, measured horizontally, from other utilities, or as required by the utility company, whichever is greater.
- E. Galvanized iron pipe may only be used where specifically shown on the Drawings and as approved by the Owner.
- F. Pipe shall be installed in accordance with the manufacturer's instructions, the Technical Specification section titled "**Excavation, Backfill, and Compaction,**" and the AWWA and ASTM standards listed below by pipe material:
 - 1. Steel pipe and fittings shall be installed in accordance with AWWA C604.
 - 2. Ductile iron pipe and fittings shall be installed in accordance with AWWA C600.
 - 3. PVC (C900) pipe shall be installed in accordance with AWWA C605.
 - 4. Copper pipe and fittings shall be installed as specified herein.
 - 5. Polyethylene (AWWA C901) pipe and fittings shall be installed in accordance with AWWA Manual M55 (Chapter 8).

3.02 CONNECTIONS TO EXISTING SYSTEMS

- A. The Contractor shall field verify existing pipeline location (horizontal and vertical), depth and material, size, roundness, and connection type prior to construction and submit data to the Owner for review.
- B. The Contractor shall coordinate with the Engineer and the City to schedule a shutdown for each system connection. For bidding purposes, assume that advanced notice of fourteen (14) calendar days is required and that the shutdown duration will be limited to no more than forty-eight (48) hours. The Contractor is also required to notify the City and residents and businesses located within the affected shutdown area with an advanced notice of fourteen (14) calendar days. Upon the Engineer's approval, the Contractor may be allowed to work extended hours during the shutdown period.
- C. All approved materials and tools and equipment required to complete the tie-in work shall be onsite a minimum of three (3) days prior to the City approved shutdown date. The Engineer will

verify that the required items are onsite. The Contractor shall provide three (3) days advance notice and coordinate with the Engineer for materials inspection. A failed inspection shall result in the restart of the shutdown process and notification.

- D. The City will be responsible for isolating and dewatering the existing pipelines prior to the approved system shutdown date. Note that the pipelines will not be completely dewatered, and the Contractor shall expect nuisance water. This water shall not enter the excavation or trench. Disposal of the nuisance water shall be in accordance with all applicable state, federal, and local laws. The Contractor's dewatering activities shall take place outside of the approved shutdown period.
- E. Connections and new pipe shall be pressure tested and disinfected as specified herein.

3.03 HANDLING OF PIPE

- A. Moving Pipe: Pipes shall be lifted with handling beams or wide belt slings as recommended by the pipe manufacturer. Cable slings shall not be used. Pipe shall be handled in a manner to avoid damage to the pipe. Pipe shall not be dropped or dumped from trucks or into trenches under any circumstances.
- B. Internal Pipe Braces: Internal braces placed in steel pipes shall be maintained until backfilling and compaction are completed.
- C. Pipe Caps: Plastic caps placed over the ends of steel pipe shall not be removed until the pipe is ready to be placed in the trench. Plastic caps may be opened temporarily to spray water inside the pipe for moisture control.
- D. Inspection of Pipe: The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged, or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench.

3.04 PLACEMENT OF PIPE IN TRENCH

- A. General: Dewatering, excavation, shoring, sheeting, bracing, backfilling material placement, material compaction, compaction testing, and pipe laying requirements and limitations shall be in accordance with the Technical Specification section titled "**Excavation, Backfill, and Compaction.**"
- B. Sanitation of Pipe Interior: During laying operations, tools, clothing, or other materials shall not be placed in the pipe.
- C. Prevention of Entry into Pipe: When pipe laying is not in progress, including lunch-hour, the ends of the pipe shall be closed using plugs constructed in a manner to prevent entry by any debris, animal, or vermin.
- D. Laying Pipe on Grades over 5 Percent: Pipes shall be laid uphill with the bell or collared joints on the uphill end of each pipe length, whenever the grade exceeds five percent.
- E. Pipe Base Thickness: Pipe base thickness shall be as specified in the Technical Specification section titled "**Excavation, Backfill, and Compaction.**"

- F. Depressions at Joints and Pipe Sling Points: Depressions shall be dug into pipe base material to accommodate the pipe bell and external joint filler form ("diapers"), and to permit removal of the pipe handling slings.
- G. Placement of Pipe-on-Pipe Base: Pipe shall be lowered onto the bedding and installed to line and grade its full length on firm bearing except at the bell and at sling depressions.
- H. Acceptable Line and Grade for Piping: The pipe shall be laid true to the line and grade shown on the Plans within acceptable tolerances. Unless otherwise shown or specified, the tolerance on grade is 1-inch and the tolerance on alignment or line is 2-inches. Grade shall be measured along the pipe invert.
- I. Pipe Installation: Pipe shall be installed without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Precautions shall be taken to prevent pipe from being displaced by water entering trench. Damaged or displaced pipe shall be replaced or returned to specified condition and grade. As soon as possible after the installation of the pipe, sufficient backfill material shall be placed on the pipe to protect it from temperature changes.
- J. Trench Curvature and Pipe Deflection: The radius of curvature of the trench shall be determined by the maximum length of pipe section that can be used without exceeding the allowable deflection at each pipe joint and without causing deviation from the trench width requirements as shown. The deflection at any flexible joint shall not exceed that prescribed by the manufacturer of the pipe.
- K. Equipment for Installation of Pipe: Proper implements, tools, and facilities as recommended by the pipe manufacturer's standard printed installation instructions shall be provided and used by the Contractor for safe and efficient execution of the Work. All pipe, fittings, valves, and accessories shall be carefully lowered into the trench using suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.
- L. Cutting and Machining Pipe: Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, nor any other method that may fracture the pipe or produce ragged, uneven edges.

3.05 ASSEMBLING RUBBER-GASKETED JOINTS

- A. Cleaning Ends of Pipe: The ends of the pipe to be joined shall be cleaned of foreign material.
- B. Lubrication: After placing pipe in trench, a nontoxic water-soluble vegetable soap solution shall be applied to the inside of the bell of the pipe in the trench and to the rubber gasket and spigot of the pipe to be installed. The rubber gasket shall be stretched into the groove in the bell-end of the pipe and distributed uniformly around the circumference.
- C. Joint Assembly: Without tilting the pipe to be installed, the spigot shall be inserted into the bell of the pipe. Come-a-longs or pipe jacks shall be used to drive spigot end into the bell until properly seated. The joint recess recommended by pipe manufacturer for made-up joints shall be maintained. Where deflections at joints are required for curved alignment, the manufacturer's recommended allowable joint opening on one side shall not be exceeded. This also applies to restrained joints. A feeler gauge shall be used to verify proper placement of each gasket.

3.06 FITTINGS

- A. Fittings shall be installed utilizing standard installation procedure. Fittings shall be lowered into the trench by means of rope, cable, chain, or other acceptable means without damage to the fittings. Cable, rope, or other devices used for lowering fitting into trench, shall be attached around exterior of the fitting for handling. Under no circumstances shall the cable, rope, or other device be attached through the fitting's interior for handling.
- B. Joints of bell and spigot fittings shall be made up and sealed as specified for pipe joints.
- C. Joints of flanged fittings shall be made up true and square so that there is no strain on the pipe or fitting. Bolts shall be tightened uniformly around the joint. Fittings shall be carefully connected to the pipe and the joint shall be checked to insure a sound and proper joint.
- D. Fittings shall be wrapped with eight (8) mil. sheet polyethylene film as specified herein.

3.07 MECHANICAL JOINT CONNECTIONS WITH RETAINER GLAND RESTRAINTS

- A. Mechanical joint connections with retainer glands shall be assembled in accordance with the manufacturer's recommendations for the specific fitting and retainer gland. Torquing of break-off gland bolts shall be done in the presence of the City of Orland Representative. Each fitting shall be observed by the Engineer's Representative prior to bagging and backfill. Any such fittings not observed by the Engineer's Representative shall be excavated and exposed for detailed re-inspection of the fitting and bolt torque at no additional cost to the City.

3.08 FLANGED CONNECTIONS

- A. Bolt Hole Alignments
 - 1. Pipe shall be set with flange bolts straddling the pipe horizontal and vertical centerlines. Use torque-limiting wrenches to provide uniform bearing and proper bolt tightness. Tighten flange bolts progressively, drawing up bolts on opposite sides gradually until bolts have uniform tightness around the flange.
- B. Nuts, Bolts, and Washers
 - 1. Nuts and bolts shall be lubricated with anti-seize, recommended for use with stainless steel prior to installation. Washers shall be provided for each nut and shall be installed adjacent to the nut, between the nut and the flange. The length of each bolt or stud shall be such that between 1/4-inch and 1/2-inch will project through the nut when drawn tight. Use torque-limiting wrenches to provide uniform bearing and proper bolt tightness. Tighten flange bolts progressively, drawing up bolts on opposite sides gradually until bolts have uniform tightness around the flange. Exposed bolt heads and threads shall be coated with grease.
- C. Flange Wrapping
 - 1. Flanges which connect with buried valves, fittings, couplings, or other equipment shall be wrapped with sheet polyethylene film as specified herein for fittings, valves, and equipment. The wrap shall be extended over the flanges and bolts and secured around the adjacent pipe circumference with tape. For insulating joints, wrapping shall be as specified herein.

3.09 FABRICATED STEEL PIPE AND FITTINGS

A. Fabrication

1. Reference Standards

- a. Fabrication shall comply with ANSI B31.3, Chapter V. Welding procedure and performance qualifications shall be in accordance with Section IX, Articles II and III, respectively, of the ASME Boiler and Pressure Vessel Code.

B. Welding

- 1. The pipe cylinder shall be fabricated by butt welding, spiral seam, or straight seam. Girth welds shall be limited to two per pipe section, butt welded. Longitudinal welds shall be limited to one seam. Longitudinal joints of adjacent shell courses shall be staggered.
- 2. Field welded joints, if shown and/or allowed by the Engineer, shall be in accordance with AWWA C206.
- 3. The minimum number of passes for welded joints for steel cylinder thickness 0.2500 inches and less shall be two. Three for steel cylinder thickness between 0.2501 and 0.3750 inches. All welds shall be continuous and fully circumferential.
- 4. For the shop fabrication of special fittings and appurtenances, the shielded metal arc welding (SMAW) process shall be used. Other process can be used if approved by the Engineer. All welding shall be done by qualified, certified welders.
- 5. Welds shall be in accordance with ANSI B31.3, paragraph 327.4.
- 6. Welds shall be identified in accordance with ANSI B31.3, paragraph 328.5.
- 7. Welding preparation shall comply with ANSI B31.3, paragraph 328.4.
- 8. Welding preparation shall comply with ANSI B31.3, paragraph 327.3. Limitations on imperfections in welds shall conform to the requirements in ANSI B31.3.
- 9. For the SMAW process, welding electrodes shall comply with AWS A5.1. For the SAW process welding electrodes shall comply with AWS A5.17. For the FCAW process welding electrodes shall comply with AWS A5.20.
- 10. Each layer of deposited weld metal shall be cleaned using a power-driven wire brush prior to depositing the next layer of weld metal. The final pass shall be cleaned by a power-driven wire brush.
- 11. Beveled ends for butt welding shall conform to ANSI B16.25. Slag shall be removed by chipping or grinding. Surfaces shall be clean of paint, oil, rust, scale, slag, and other material detrimental to welding. When welding the reverse side, slag shall be chipped out before welding.

C. Shop Hydrostatic Test

- 1. The steel cylinder with joint rings shall be stressed to 75% of the minimum yield stress of the steel.

D. Shop Testing of Fittings

1. Dye Penetrant Test: Seams in fittings which have not been previously shop hydrostatically tested shall be tested by the dye penetrant method as described in ASME Boiler and Pressure Vessel Code Section VIII, Appendix B.
2. Air-Soap Test: In addition to the dye penetrant method of testing, the air-soap method with air at 5 psi shall be used on joints susceptible to being tested by such a method.
3. Pressure Test in Lieu of Dye Penetrant Test: In lieu of the dye penetrant method of testing, completed fittings may be hydrostatically tested using the field hydrostatic test pressure or 125% of the design pressure, whichever is higher.

3.10 COPPER PIPE

A. Pipe/Tubing Preparation

1. Tubing shall be cut square and burrs removed. Both the inside and outside of fitting and pipe ends shall be cleaned with steel wool and muriatic acid before soldering. Care shall be taken to prevent annealing by over-heating of fittings and tubing when making connections. Miter joints shall not be permitted in lieu of elbows. Notching straight runs of pipe in lieu of tees shall not be permitted.

B. Pipe Bends

1. Bends in soft copper tubing shall be long sweep. Bends shall be shaped with shaping tools. Bends shall be formed without flattening, buckling, or thinning the tubing wall at any point.

C. Brazing

1. Brazing procedures shall be in accordance with Articles XII and XIII, Section IX, of the ASME Boiler and Pressure Vessel Code. Solder shall penetrate to the full depth of the bell in joints and fittings. Solders shall comply with ANSI B31.3, paragraph 328.

D. Pipe Flexibility and Minimum Cover for Service Laterals

1. Buried piping shall be installed with some slack to provide flexibility in the event of a load due to settlement, expansion, or contraction. The minimum depth of cover shown on the Drawings shall be adhered to.

E. Copper Service Laterals

1. All copper service laterals shall be the size shown on the Drawings. End connections for the corporation stop shall be compression type fittings. All other couplings, fittings and joints shall be silver soldered. Piping for 2-inch size services shall be installed with straight lengths of soft copper water tube Type K.

3.11 POLYETHYLENE PIPE

- A. Polyethylene piping is allowed for water services. Water service piping from water main to meter shall be one continuous length and shall not have any joints.

3.12 COMPLETION OF INTERIOR JOINTS FOR MORTAR-LINED PIPES

A. Preparation

1. A tight-fitting swab or squeegee shall be inserted in the joint end of the pipe to be joined.
- B. Application of Cement Mortar
1. When ready to insert the spigot, the face of the cement mortar lining at the bell shall be coated with a sufficient amount of stiff cement mortar to fill the space between adjacent mortar linings of the two pipes to be joined.
- C. Removal of Excess Mortar
1. Immediately after joining the pipes, the swab or squeegee shall be drawn through the pipe to remove all excess mortar and expel it from the open pipe end.

3.13 PIPELINE CLOSURE ASSEMBLIES

- A. Pipeline closure assemblies shall be employed to unite sections of pipeline laid from opposite directions, to adjust the field length of the pipeline to meet structures, tie-ins to existing pipelines, and points established by design stations, and to close areas left open to accommodate temporary test bulkheads for hydrostatic testing.
- B. PVC C900 Pipe
1. Closure assemblies shall be an ASTM C 153 ductile iron restrained mechanical joint long sleeve, manufactured by Tyler Union or equal.
- C. AWWA C200 Steel Pipe
1. Unless otherwise shown, closure assemblies shall be butt straps.
 - a. Unless otherwise shown or specified, shaped steel butt straps a minimum of 10-inches in width shall be centered over the ends of the pipe sections they are to join. Provide a minimum of 2-inches of overlap on each side and holes for air-soap test. Butt strap thickness shall match pipe at a minimum. Provide backing plate the full width of the joint/splice. On pipes 39 inches in diameter and smaller, butt straps shall be welded to the outside of the pipes with complete circumferential fillet welds equal in size to the thinnest part being joined.
 - b. Submit locations and details for Engineer review and approval.
 2. General Requirements for Cement Mortar Lining for Closure Assemblies
 - a. Closure assemblies shall be cement-mortar lined to a mortar thickness at least equal to the adjoining standard pipe sections. The steel shall be cleaned with wire brushes and a cement and water wash coat applied prior to applying the cement mortar. Where more than a 4-inch joint strip of mortar is required, welded wire mesh reinforcement having a 2-inch by 2-inch pattern of No. 12 gauge shall be placed over the exposed steel. The wires on the 4-inch spacing shall be crimped to support the mesh 3/8-inch from the metal surface. The interior mortar shall have a steel-troweled finish to match adjoining mortar lined pipe sections.
 3. Lining Closure Assemblies

- a. Butt straps with 5-inch diameter hand holes shall be provided for lining of closure assemblies on pipelines, as shown.
- 4. Mortar Coating Exterior Surfaces of Closure Assemblies
 - a. The exterior of closure assemblies shall be reinforced with wire mesh as described in paragraph titled "General Requirements for Cement Mortar Lining for Closure Assemblies" above. The surface shall be coated with mortar, or a poured concrete encasement to cover all steel to a minimum thickness of 1 1/2 inches. Exterior mortar shall be protected to retard drying while curing. Concrete shall be poured and vibrated on one side of the closure assembly only, until mortar is visible on the opposite side, after which the coating can be completed over the top of the assembly.

3.14 FIELD WELDED JOINTS

A. Locations

- 1. Welded joints shall be provided where detailed on the Plans.

B. Reference Standard

- 1. Welding shall be in accordance with AWWA C206. Welder's qualification shall be in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. Current certifications shall be provided for all welders.

C. Sequence

- 1. Interior joints shall not be welded before backfilling, compaction, and compaction testing are successfully completed.

D. Joint Rings

- 1. Joint rings (butt-straps or weld collars) that are rusted or pitted where weld metal is to be deposited shall be cleaned by brushing or sand blasting.

E. Restrictions

- 1. Concrete or other coating adjacent to the joint rings shall not be heated.

F. Cleaning Requirements

- 1. Each layer of deposited weld metal shall be cleaned using an appropriate power-driven wire brush or grinder prior to depositing the next layer of weld metal.

3.15 OPERATIONS INCIDENTAL TO JOINT COMPLETION

A. Hydrostatic Testing

- 1. Joint completion shall be planned to accommodate temporary test bulkheads for hydrostatic testing.

3.16 COMPLETION OF EXTERIOR PIPE JOINT FOR CEMENT-MORTAR COATED PIPE

- A. Outside joint recess shall be filled with cement-mortar grout using a fabric form (joint diaper) placed around the joint and secured with steel straps. Grout shall be poured and rodded from one side only until it is visible on the opposite side. After approximately one hour, the joint shall be topped off with additional grout.

3.17 POLYETHYLENE ENCASEMENT

- A. Polyethylene encasement wrap of all ferrous pipes, fittings (all material types), couplings, and valves buried underground shall be accordance with AWWA C105. Valves, tees, and crosses require two layers of polyethylene encasement wrap.

3.18 FLEXIBLE COUPLINGS AND FLANGED COUPLING ADAPTERS

- A. Flexible couplings and flanged coupling adapters shall be installed in accordance with the recommendations of the manufacturer. The finished joint shall be watertight under the test pressure of the pipeline. Couplings and adapters shall be wrapped with eight (8) mil. sheet polyethylene film as specified herein.

3.19 IDENTIFICATION AND LOCATOR TAPE

- A. Pipe locator tape shall be installed above the pipe as shown and in accordance with the Technical Specification section titled “**Facility Identification.**”

3.20 TRACER WIRE

- A. Tracer wire shall be installed on top of the pipe as shown and in accordance with the Technical Specification section titled “**Facility Identification.**”

3.21 FLANGE INSULATION KITS

- A. Flange insulation kits shall be installed in accordance with the manufacturer’s instructions.
- B. Buried Insulation Kits
 - 1. Flange insulation kits shall not be installed directly against valve flanges. A 24-inch-long spool of identical material shall be installed adjacent to the valve (on each side, where applicable) so that the insulating flange kit may be installed on a standard pair of flanges. All buried insulated flanges (and adjacent fittings, pipe spools, and valves) shall be protected with a polyethylene encasement wrap in accordance with AWWA C105 and as specified herein.
- C. Above Ground Insulation Kits
 - 1. All flange and pipe surfaces shall be clean and free of all dirt, grease, water, and other foreign material in accordance with the tape (vinyl plastic electrical tape) manufacturer’s requirements prior to installation of tape coating. The two separate 20-mil tapes shall be half-lapped twice over the outer surface of the flange.

3.22 THRUST RESTRAINT AND ANCHOR BLOCKS

- A. Location

1. Thrust restraint and anchor blocks shall be provided on all pressure pipelines and shall be installed as shown on the Plans at all rubber gasketed fittings that are not otherwise restrained. Thrust restraint blocks or anchor blocks shall be installed at all valves, tees, crosses, ends of pipelines, and at all changes in direction of the pipeline greater than five (5) degrees deflection either vertically or horizontally when joints are not otherwise restrained.
- B. General Requirements
1. Concrete for thrust blocks shall be Class C and shall conform to the Technical Specification section titled “**Concrete Work.**”
 2. Thrust protection shall be set prior to pressurizing the line. Exposed reinforcement shall be coated with one (1) inch of an approved non-shrink grout after the concrete has sufficiently cured. See the Technical Specification section titled “**Concrete Work.**”
- C. Thrust Restraint Not Called for on the Drawings
1. Thrust restraint elements, where not called for on the Plans, shall be sized for 150 percent of operating pipeline pressure or the pipeline test pressure, whichever is greater. Prior to construction, thrust and anchor block sizing shall be submitted to the Owner for approval.
- D. Concrete Placement
1. Concrete shall be placed against wetted and undisturbed soil, forms, and the exterior of the fitting. The forms and exterior of the fitting shall be cleaned and wetted to provide a good bond with the concrete. The concrete interface with the fitting shall be an area of not less than the projected area of the fitting normal to the thrust resultant and centered on the resultant. Cure concrete in accordance with the Technical Specification section titled “**Concrete Work.**” Concrete shall set prior to pipeline hydrostatic testing.
- E. Disturbed Soil
1. Where soil is disturbed, horizontally and vertically, the Contractor shall extend the excavation line as directed by the Owner. Material, lift thickness, and compaction of the backfill shall be as directed by the Owner.
- F. Accessibility to Joints and Fittings
1. Unless otherwise directed by the Owner, thrust restraint and anchor blocks shall be placed so that the pipe and fitting joints are accessible for repair. Placement shall include isolation of adjacent utilities and shall ensure that the bearing is against undisturbed soil.
- G. Harness and Tie-Rods
1. Metal harness or tie-rods and pipe clamps shall be used to prevent movement if shown on the Plans or directed by the Owner. The rods and clamp harnessing arrangement shall be installed utilizing flanged harness hold downs or lugged fittings and pipe with saddle clamps placed (where feasible and practical) to bear against the pipe bells. Saddle clamps around the barrel of the pipe, which depend on friction to prevent sliding of the clamp, are acceptable. However, restraints with pointed set-screws which bear into the pipe wall are not acceptable and shall not be used. All bolting materials shall be 316 stainless steel and wrapped with polyethylene prior to backfilling the pipe.

H. In-line Valves

1. Reinforcing steel tiedowns rods shall be used on all in-line valves. Refer to the Plans for details. Exposed reinforcement shall be coated with one (1) inch of an approved non-shrink grout after the valve pad or anchor has sufficiently cured. Alternatively, the exposed reinforcing steel can be coated with 80 mils of nontoxic cold-applied bitumastic waterproofing compound that conforms to ASTM D1227.

3.23 ABOVE-GROUND PIPING INSTALLATION/SUPPORT

A. Installation of aboveground pipeline materials and appurtenances include requirements for buried pipeline materials and appurtenances as applicable.

B. Supports

1. All exposed pipes shall be adequately supported with devices of appropriate design in accordance with the Technical Specification titled "**Pipe Supports**". Where details are shown, the supports shall conform thereto and shall be placed as indicated; provided, that the support for all piping (existing and new) shall be complete and adequate as herein specified, whether or not supporting devices are specifically called for.

C. Grooved-End Pipe and Fittings

1. Grooved-end pipe and fittings shall be installed in accordance with the coupling manufacturer's recommendations and the following:
2. Loose scale, rust, oil, grease, and dirt shall be cleaned from the pipe or fitting groove. Lubricate the coupling gasket in accordance with the manufacturer's recommendations. Coupling shall be tightened alternately and evenly until coupling halves are seated properly.

3.24 HYDROSTATIC TESTS

A. All parts of the entire pipeline installation (mains, laterals, blowoffs, valves, air valves, and water services) shall be tested in accordance with applicable sections of AWWA C600 and AWWA C605.

1. Water services shall be tested up to the curb stop.

B. Connections to existing lines and tests shall be made in the presence of the City of Orland Representative. The Contractor shall notify the Owner at least seventy-two (72) hours prior to installing the testing block and bypass and testing.

C. The Contractor shall furnish and install a testing block and bypass as shown. The bypass shall be used for filling, flushing, sterilization, and chlorination of the water lines. On exposed water mains, the acceptance test shall be conducted after the piping has been completely installed, including all supports and hangers.

D. The Contractor shall submit a comprehensive testing plan and a test report for each section.

E. The Contractor shall provide all labor, tools, and equipment required to perform the hydrostatic tests.

F. Testing

1. Before the test, the pipeline shall be sufficiently anchored to withstand the test pressure. During the filling of the line with water, precautions shall be taken to prevent air pockets at high points.
2. Water may be allowed to stand in the line for several hours prior to the test. Water shall sit in the line for a minimum of 72 hours for cement mortar-lined pipelines.
3. Test pressure shall be 100 PSI or as directed by the Engineer.
4. During the test, which shall be conducted for the time period determined by the Owner, but not less than 30 minutes, the leakage shall not exceed 5 gallons per 24 hours per thousand feet of pipe per inch of nominal diameter. Note that the allowable leakage rate for pipeline sections with flanged, welded, and/or grooved-end joints shall be zero.
5. The maximum length of pipe to be included in any one test shall not exceed 2,500 feet or the distance between the isolation valves, whichever is greater. Suitable test bulkheads, blocking, and fittings shall be installed as necessary to permit such sectionalizing.
6. If any valved section of pipe shows greater leakage than specified, the Contractor shall locate and repair the leaks and shall retest that section of line at no additional cost to the Owner.

3.25 FLUSHING AND STERILIZATION OF COMPLETED MAINS

- A. Flushing and sterilization of completed mains shall be in accordance with Technical Specification section titled **“Disinfection of Water Mains, Pump Stations, and Reservoirs.”**

PART 1 GENERAL

1.01 SCOPE

- A. This section describes the requirements to locate, excavate, expose, and determine (“pothole”) the exact location, depth, material, and size of each and every utility shown and located in the field.
- B. Provide materials, equipment and labor required to execute this Work as indicated on the Drawings, specified herein, and necessary to complete the Work of this section.

1.02 RELATED SECTIONS

- A. Supplementary General Conditions, General Conditions, Division 1 sections, and Drawings apply to this section.

1.03 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled “**Submittals.**”
- B. The Contractor shall submit a comprehensive potholing plan that includes the following items:
 - 1. Potholing supervisor and staff qualifications and experience.
 - 2. Potholing equipment and methods.
 - 3. Backfill and compaction methods and materials in right of way and private property.
 - 4. Sample pothole data sheet.
 - 5. Existing lines to be potholed and intervals for parallel utilities.
 - 6. Plan for protecting existing utilities in place.
 - 7. Safety plan.
 - 8. Disposal site.
- C. Submit potholing results in a single comprehensive report.
- D. Deviations from Drawings:
 - 1. Submit immediate written notification to the Engineer where shown utilities deviate from field conditions.
 - 2. Submit immediate written notification to the Engineer if unmarked/unknown utilities are found.

1.04 QUALITY ASSURANCE

- A. Comply with applicable County and City permits and regulations.
- B. Comply with utility owners’ notification, inspection, and crossing requirements.

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- C. Use workers who are thoroughly trained and experienced in the Work, who are completely familiar with the specified requirements and methods needed for proper performance of the Work in this section.
- D. The Contractor shall have a sufficient supply of repair or replacement materials on the job site to repair or replace damaged or destroyed facilities including, but not limited to, sewer laterals, sewer mains, water mains, storm drains, irrigation lines, and water services.

PART 2 MATERIALS

2.01 GENERAL

- A. All materials, labor, and equipment shall conform to these Technical Specifications.

PART 3 EXECUTION

3.01 GENERAL

- A. The location and existence of substructures were determined from a search of records maintained by their owners during the design phase.
- B. The location and existence of substructures shown were not determined by exploratory excavations performed during the design phase.
- C. The location of said utilities shown on the Drawings are considered to be approximate. No guarantee is made or implied that the information is complete or accurate. It shall be the Contractor's responsibility alone to determine the exact location of substructures of every nature and to protect them from damage.
- D. All facilities shown specifically on the Drawings, and which have been marked by their respective owners, shall be potholed.
- E. Sewer laterals, where shown, are based on limited available records. Sewer laterals are shown both in plan and profile views, but they are not identified with interference flags.
- F. Drain lines, where shown, are based on limited available records. Drain lines are shown both in plan and profile views, but they are not identified with interference flags.
- G. Irrigation water lines and locations, where shown, are based on limited available records and approximate locations of farm turnouts and existing valve boxes. Irrigation water lines are shown both in plan and profile views, but they are not identified with interference flags.
- H. Gas transmission lines, distribution lines, and service laterals, where shown, are based on approximate location of visible "gas" markings and/or limited records obtained from the Owner. Gas lines are shown both in plan and profile views, but they are not identified with interference flags.
- I. Underground electrical lines, where shown, are based on limited records obtained from the Owner. Underground electrical lines are shown both in plan and profile views, but they are not identified with interference flags.

- J. Communication lines, where shown, are based on approximate location of visible markings, and limited records obtained from the Owner. Communication lines are shown both in plan and profile views, but they are not identified with interference flags.
- K. Overhead facilities, including, but not limited to, electrical facilities, cable facilities, and telephone facilities are shown in plan views only; they are not shown in the profiles, and they are not identified with a utility interference flag.
- L. Where underground main conductors or conduits such as water, gas, telephone, electric power, cable television, or other utilities are shown on Drawings, the Contractor shall assume that a service lateral from each utility facility extends to every parcel or property, whether or not a service lateral is shown.

3.02 TRAFFIC CONTROL

- A. Traffic Control shall be in accordance with the Technical Specification section titled “**Traffic Control.**”

3.03 NOTIFICATION

- A. The Contractor is responsible for calling Underground Service Alert at 811 at least 48 hours before any excavating, potholing, or trenching work.
- B. Utilities located on private property may not be marked through USA. It is the Contractor’s responsibility to contact each Landowner at least two (2) weeks before any excavating, potholing, or trenching work and request that all irrigation and other service lines be marked.
- C. The Contractor is responsible for marking on the ground the location of the excavated area. In addition, the Contractor shall request that the Owner’s representatives be onsite during potholing of all non-City owned underground facilities. Representatives of some and/or all affected utilities may be present at the preconstruction meeting; however, their presence at the preconstruction meeting shall not relieve the Contractor of the responsibility of notifying each utility prior to beginning any Work.
- D. Any list of names and telephone numbers for utility or substructure owners shown on the Drawings or in any other Contract document is intended for the convenience of the Contractor and is not guaranteed to be complete or correct.

3.04 POTHOLING

- A. At least thirty (30) business days prior to any construction, including saw-cutting or grading pavement, the Contractor shall excavate, expose, and determine (“pothole”) the exact location (horizontal and vertical alignment), materials of construction, and depth of each and every utility crossing the proposed pipelines as well as the connection locations to the existing facilities at least 2,500 feet ahead of a pipe trench heading to provide sufficient lead-time to resolve utility conflicts. The Contractor shall also pothole at 200-foot intervals, but not less than the start and end where lines parallel the proposed lines, or other interval required/approved by the Engineer, all facilities that are parallel with, and within twenty (20) feet, of the proposed pipelines, as marked in the field by their respective owners and shown on the Drawings to determine exact location of said facilities.

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- B. All potholing shall be completed, and the results furnished to the City at least twenty (20) business days prior to any construction, including saw-cutting or grinding pavement.
- C. At all locations where the Contractor is required to tie-into existing City owned pipelines, the Contractor shall pothole to determine the exact location (horizontal and vertical alignment), pipe materials, and pipe dimensions prior to procuring any materials. The Contractor shall be responsible for determining if connections can be completed as shown on the Plans or if design modifications need to be considered by the Engineer. If discrepancies are found, the Contractor shall immediately notify the Engineer so the appropriate changes can be made.
- D. It shall be the Contractor's responsibility to make exploratory excavations (by "hand" where prudent) to determine the true location, depth, size, material, condition, and roundness of all utilities shown on the Plans.
- E. The Contractor shall protect all utilities crossing and parallel to the proposed pipelines in place, all based on the Contractor's field measurements and at no additional cost to the City.
- F. If utility locations or tie-ins to City facilities vary from those shown on the Drawings, the Engineer may redesign alignment of pipelines. The Contractor shall construct the pipelines in accordance with the redesigned alignment at no additional cost to the City. Changes or delays caused by the Contractor's failure to perform "potholing" and interference location work shall not be eligible for extra work compensation or time extension.
- G. Upon learning of the existence or location of any utility facility omitted from or shown incorrectly on construction drawings, or improperly marked or otherwise indicated, the Contractor shall immediately notify the Engineer, providing full details as to depth below existing grade, location, size (outside diameter), and function. The Contractor shall immediately notify utility having jurisdiction over facility.

3.05 REPAIR AND REPLACEMENT OF EXISTING UTILITIES

- A. The Contractor shall not interrupt or disturb any utility facility without authority from the utility company, Landowner, or order from the City. Where protection is required to ensure integrity of utility facilities located as shown on the Drawings, visible to the Contractor, or marked or otherwise indicated as stated herein, the Contractor shall, unless otherwise provided, furnish and place all necessary protection at no additional cost to the City.
- B. The Work requires the Contractor to construct proposed pipelines and structures adjacent to existing utilities (water, sewer, gas, telephone, electric power, cable TV, compressed air, etc.) and existing improvements (sidewalks, driveways, pump stations, replenishment ponds, reservoirs, etc.). The Engineer and City do not have any information about compaction of trench backfill for said utilities and improvements. If said trench backfill fails during construction of proposed pipelines and structures, the Contractor shall remove and replace said backfill, repair existing facilities (if damaged), compact as specified herein, and remove and replace any asphalt concrete pavement and Portland cement concrete as required, all at no additional cost to the City.
- C. The Contractor shall have a sufficient supply of repair or replacement materials on the job site to repair or replace damaged or destroyed facilities including, but not limited to, sewer laterals, sewer mains, water mains, storm drains, irrigation lines, and water services. Repairs shall be made with like materials and said repairs shall be approved by the Engineer, and owners of damaged utilities prior to backfill.

3.06 RESTORATION

- A. After the completion of Work in planted or improved areas within public or private easements, the Contractor shall restore such areas to original condition and in accordance with City of Orland.
- B. Two (2) working days after the conclusion of the Contractor's work at each site/location, all remaining field markings related to the Project made by the various utilities using USA shall be removed by the Contractor, as directed by the Engineer.



PART 1 GENERAL

1.01 SCOPE

- A. This section covers installation of new gravity storm drain pipe, fittings and appurtenances. Excavation and backfill shall conform to the requirements of the Technical Specification section titled "**Excavation, Backfill, and Compaction.**"

1.02 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled "**Submittals.**"
- B. Material List and Specifications
1. Affidavits of compliance with standards referenced in this specification shall be provided.
 2. Submit materials list and manufacturer's specification sheets showing material of pipe, fittings, joint restraint, and appurtenances with ASTM reference and grade.
 3. Submit lining, coating, and thicknesses.
 4. Joint details for all types of joints used shall be submitted.
 5. Submit materials list and manufacturers specification sheets of deflection test mandrel.
- C. Testing
1. Submit a comprehensive hydrostatic, or air testing and a test report for each section.
 2. Submit a comprehensive deflection testing and test report for each section.

PART 2 MATERIALS

2.01 PVC GRAVITY STORM DRAIN PIPE

- A. PVC larger than 4-inch shall be integral bell and spigot pipe conforming to ASTM Specification D3034, F679, with a maximum standard dimensional ratio (SDR) of 35. Provisions must be made for contraction and expansion at each joint with a rubber ring gasket conforming to ASTM F477 and/or ASTM D3212. Fittings and accessories shall be as manufactured and furnished by the pipe supplier, or approved equal, and have bell and/or spigot configurations compatible with that of the pipe.
- B. PVC pipe 4 inches and smaller shall be SR (Schedule Rated) in accordance with ASTM D1785 for Schedule 40 pipe and suitable for solvent weld joints. Fittings shall be Schedule 40 socket fittings conforming to ASTM D2466.
- C. Minimum "pipe stiffness" at 5% deflection shall be 46 psi for all sizes when tested in accordance with ASTM Test Method D2412.
- D. Maximum pipe deflection shall not exceed 5% of the nominal manufacturer's average inside pipe diameter and shall be determined as specified in the paragraph of this Specification titled "Deflection Test."

2.02 DUCTILE IRON PIPE

- A. Ductile iron pipe shall be Class 50 ductile iron pipe conforming to AWWA Specification C151. Pipe shall be bell and spigot with “push on” rubber gasket joints conforming to AWWA Specification C111, unless otherwise specified. Pipe shall be cement-mortar lined and bituminous coated.
- B. Fittings shall comply with AWWA Specification C110 and shall be cement-mortar lined and bituminous coated as specified above. Fittings shall be supplied with bell and/or spigot configurations compatible with that of the pipe, unless otherwise specified.

2.03 MECHANICAL COUPLINGS,

- A. Mechanical Couplings including flexible couplings and flanged coupling adapters, shall be as manufactured by Rockwell, Baker, Romac or approved equal. All mechanical couplings shall have the longest standard sleeve length and shall be provided with thrust anchors.

2.04 DEFLECTION TEST MANDREL

- A. The deflection test mandrel for testing of flexible pipe shall be a full circle, solid cylinder, or a rigid, nonadjustable, odd-numbered leg (9-leg minimum) steel cylinder, accepted by the Owner as to design and manufacture. The circular cross section of the mandrel shall have a diameter of at least 95 percent of the specified average inside diameter of the pipe and the minimum length of the circular portion of the mandrel shall be equal to the nominal diameter of the pipe.
- B. Mandrel shall be Hurco, or equal.

2.05 TESTING MATERIALS AND EQUIPMENT

- A. General
 - 1. Temporary valves, plugs, bulkheads, measuring devices, and other required testing and water control equipment and materials shall be provided by the Contractor and subject to the Owner’s review. No materials shall be used that will be injurious to pipeline structure and future function. Air test gages shall be laboratory-calibrated annually and shall be recalibrated by a certified laboratory at the Contractor's expense prior to the leakage test.

PART 3 EXECUTION

3.01 PREPARATION OF THE TRENCH

- A. The trench shall be prepared to receive the pipe as specified in the Technical Specification section titled “**Excavation, Backfill, and Compaction.**” The excavation and preparation of the trench shall be completed a sufficient distance in advance of the pipe laying to prevent dislodged material from entering the pipe.

3.02 INSTALLATION OF THE PIPE

- A. Before lowering into the trench, the pipe shall be inspected for defects, and all cracked or broken pipe shall be discarded. The ends and interior of the pipe shall be clean. Belled ends shall be laid upgrade. Handling of the pipe shall be accomplished in a manner that will not damage the pipe.
- B. After lowering the pipe into the trench, the bell or coupling end and spigot shall be cleaned of any foreign matter and a suitable lubricant applied to the joint. The joint shall be made in the manner

recommended by the manufacturer. Care shall be taken not to buckle or disturb previously laid pipe.

- C. Each joint shall be inspected to ensure that it is properly made before backfilling. Care shall be taken to prevent any dirt or foreign matter from entering the open end of the pipe. Where it is necessary to cut pipe, such cuts shall be neatly made. The laid pipe shall be true to line and grade and, when complete, the sewer shall have a smooth and uniform invert, within ± 0.02 foot vertically and ± 0.05 foot horizontally of the Plan alignment and grade.
- D. Connections to pipe stubs of a different pipe material, if any, shall be made with a mechanical coupling.

3.03 BACKFILLING THE TRENCH

- A. After the laid pipe has been inspected and approved by the Engineer or his representative, the trench shall be backfilled as required under the Technical Specification section titled **“Excavation, Backfill, and Compaction.”**

3.04 TESTING OF GRAVITY PIPELINES

- A. Hydrostatic and Air Testing
 1. All gravity pipes and service laterals shall be tested for exfiltration and deflections, as specified. At the Contractor's option, either the hydrostatic (exfiltration) or the air test may be used upon approval of the Owner for 12-inch and smaller lines.
 2. All leakage and tests of gravity systems (pipe and laterals) shall be in conformance with SSPWC Subsection 306-7.8 Gravity Pipeline Testing and as specified herein.
 3. Air pressure testing of gravity systems (pipe and laterals) shall be in accordance with SSPWC Subsection 306-7.8.2.4 except that air shall be introduced into the pipeline until 4.0 psig, instead of 30 psig, has been reached.
 4. Testing shall be performed in the presence of the City's representative.
 5. Should any testing activities specified herein indicate any pipe installation either faulty or unacceptable to the Engineer, the Contractor shall make the necessary repairs or replacements at the Contractor's expense by a method acceptable to the Engineer. Repaired or replaced pipe and/or pipe segments shall be retested. The retest shall be subject to acceptance by the Owner. All costs for scheduling, preparing for inspection, testing, retesting, installing, reinstalling, repairing, cleaning, re-cleaning, administrative costs, delays, or activities by the Contractor relating to the pipe shall borne by the Contractor at no additional cost to the Owner until testing results are acceptable as defined by the Contract Documents.
- B. Deflection Test
 1. All flexible and semi-rigid main line pipe shall be tested in accordance with SSPWC Subsection 306-7.8.3 for deflection, joint displacement, or any other obstruction by passing a rigid mandrel through the pipe by hand, not less than 30 days after completion of the trench backfill, but prior to permanent resurfacing.

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2. If flexible pipe material is used, the pipe installation shall be tested for excessive deflection after all backfill and resurfacing materials have been placed and the line has been cleaned.
3. A mandrel having an outside diameter of 95% of the average manufactured internal diameter shall be pulled through the pipeline. If the mandrel does not pass freely through the pipe, the pipe shall be re-excavated, bedded and backfilled to adequately support the pipe and reduce the pipe deflection to 5% or less. The pipeline shall then be retested for deflection.
4. Obstructions and deflections, greater than the percentage listed in SSPWC Table 306-7.8.3.1 for the applicable pipe material, encountered by the mandrel shall be corrected by the Contractor at no additional cost to the Owner.
5. The Contractor shall make the necessary repairs or replacements at the Contractor's expense by a method acceptable to the Owner. Pipe sections not meeting the deflection requirements shall be subject to an additional 30-day deflection test at no additional cost to the Owner. The cost for the deflection test shall be included in the unit price bid item for the storm drain pipe.
6. Any pipe section failing two mandrel tests shall be replaced in its entirety.

3.05 PRECAST CONCRETE STRUCTURES

- A. Precast concrete vaults and catch basins shall be constructed in accordance with the Technical Specification section titled "**Drainage Structures**" and as shown on the Drawings.

PART 1 GENERAL

1.01 SCOPE

- A. This section covers the construction of storm drain manholes and drainage inlets.
- B. Excavation and backfill at concrete structures shall conform to the Technical Specification section titled, **“Excavation, Backfill, and Compaction.”**

1.02 REFERENCES

- A. The following publications form a part of this specification to the extent referenced.
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. Standard Specifications for Highway Bridges (with CALTRANS amendments).
 - 2. American Concrete Institute (ACI):
 - a. ACI 318 Building Code Requirements for Structural Concrete (with California Building Code amendments).
 - 3. American Society for Testing and Materials (ASTM):
 - a. ASTM A 615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - b. ASTM C 150 Standard Specification for Portland Cement.
 - c. ASTM C 857 Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 - d. ASTM C 858 Standard Specification for Underground Precast Concrete Utility Structures.
 - e. ASTM C 990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
 - 4. Federal Specifications:
 - a. SS-S-00210 (GSA-FSS) Sealing Compound, Preformed Plastic, For Expansion Joints and Pipe Joints.
 - 5. Project Geotechnical Report.
 - 6. Standard Specifications for Public Works Construction (SSPWC):
 - a. Standard Specifications for Public Works Construction.
 - b. Standard Plans for Public Works Construction.

1.03 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled “**Submittals.**”
- B. Submit manufacturer's catalog data on precast concrete vaults and hatches. Show dimensions and materials of construction by ACI reference (ACI 318), ASTM reference (A 615, C 150, C 857, C 858, and C 990) and grade.
- C. Pipe penetration seals.
- D. Submit California Engineer (competent in this area of design) stamped and signed structural plan and section drawings and calculations for each precast concrete vault, including all pipe penetrations, openings, and hatches.

PART 2 MATERIALS

2.01 PRECAST CONCRETE VAULT

- A. Manufacturers:
 - 1. Precast concrete vaults and covers shall be manufactured in a plant especially designed for that purpose and shall conform to the size, shape and dimensions indicated on the detailed Plans. The applicable ASTM design standard (C 857) and manufacturer shall be stamped on the interior and exterior of vault.
 - 2. Vaults and covers shall be Christy Concrete, Cook Concrete Products, Jensen Precast; or equal.
- B. Design Loads:
 - 1. Design loads shall consist of dead load, live load, impact, and in addition, loads due to water table and any other loads which may be imposed upon the structure. Live loads shall be based on H-20 continuous loading per AASHTO Standard Specifications for highway bridges. Design wheel load shall be 16 kips. The live load shall be placed for that location which produces the maximum shear and bending moments in the structure.
- C. Concrete:
 - 1. Concrete for vaults and meter boxes units shall be structural concrete in accordance with the Technical Specification section titled “**Concrete Work.**”
- D. Sectional Vaults:
 - 1. Sectional precast concrete vaults may be used only where specified on the Drawings or approved by the Engineer.

2.02 VAULT FRAMES AND COVERS

- A. Unless noted otherwise, vault access hatches and frames shall be fabricated in accordance with the loading requirements specified herein and the requirements of the Technical Specification section titled “**Structural Steel and Miscellaneous Metalwork.**”

2.03 JOINT SEALING COMPOUND

- A. The joint sealing compound shall be permanently adhesive flexible plastic material complying with Federal Specification SS-S-00210 (GSA-FSS). Joint sealing compound shall be Quickseal by Associated Concrete Products, or equal.

2.04 CAST-IN-PLACE CONCRETE

- A. All materials used in cast-in-place concrete (curb and gutter, sidewalks) shall be Class A concrete in accordance with the Technical Specification section titled "**Concrete Work.**"

2.05 PRECAST CONCRETE MANHOLE SECTIONS

- A. All precast sections, including riser sections, cones, grade rings, and flat slab tops, shall conform to ASTM Specification C 478, and the dimensions shown on the Standard Details. Cones shall be concentric. Grade rings shall be a standard product, manufactured particularly for use in manhole construction, sized to fit the cones on which they are to be placed, and the wall thickness shall not be less than that of the cones. Grade rings shall be not less than 2-inches, nor more than 6-inches-high. All precast components shall have tongue and groove ends.
- B. All manhole construction materials shall be approved in advance by the City Engineer. Precast manhole bases, including connection details, will require specific advance approval. Neoprene "boots" are not acceptable for connections to the manhole bases.

2.06 MANHOLE FRAMES AND COVERS

- A. General
 - 1. Principal dimensions shall be as shown on the Standard Details. Iron castings shall conform to ASTM Specification A 48, Class 30. Each cover shall have the words "STORM DRAIN" cast into the top with 2-inch-high letters. Castings shall be of consistently high quality and shall be free of material and manufacturing defects. Following cleanup and final machining, an asphaltic paint or similar protective coating shall be applied.
 - 2. Covers shall have at least one blind pick hole or recessed lifting lug. Horizontal bearing surfaces shall be machined to smooth, plane surfaces providing for full contact between the frame and cover. Cover shall be South Bay Foundry SBF 1900 BPH, Phoenix Iron Works P-1090, or approved equal. Low profile frame and covers shall be D&L Supply A-1067 or approved equal.

2.07 JOINT SEALING COMPOUND COMPONENTS

- A. Joint sealing compound shall be RAM-NEK primer and joint sealing compound, KENT-SEAL primer and joint sealant, or approved equal.

2.08 MANHOLE WATER STOPS

- A. Manhole water stops shall be installed on PVC or ABS sewer pipe with stainless steel bands to make a watertight seal between the pipe wall and the concrete manhole base.

2.09 PRECAST CONCRETE DRAINAGE INLETS

- A. All precast sections, including drainage inlet boxes and tops, shall conform to ASTM Specification C 913, and the dimensions shown on the Standard Details. All precast components shall have tongue and groove ends.

2.10 DRAINAGE INLET FRAMES AND GRATES

- A. Principal dimensions shall be as shown on the Standard Details. Frames for Type G0 drainage inlets shall be galvanized, welded structural steel conforming to ASTM Specifications A 36 or A 576, Grades 1021, 1022, 1026, 1029, or 1030. Frames shall be Type 24, as shown on Caltrans Standard Plan D77A.
- B. Grates for Type G0 drainage inlets shall be bicycle proof, galvanized, welded structural steel conforming to ASTM Specifications A 36 or A 576, Grades 1021, 1022, 1026, 1029, or 1030. rates shall be Type 24-12X, as shown on Caltrans Standard Plan D77B.

2.11 MORTAR

- A. Mortar shall be proportioned with one-part portland cement to two parts clean, well-graded sand which will pass a 1/8-inch screen. Admixtures may be used not exceeding the following percentages of weight of cement: Hydrated lime, 10 percent; diatomaceous earth or other inert materials, 5 percent. Consistency of mortar shall be such that it will readily adhere to the surfaces. Mortar mixed for longer than 30 minutes shall not be used.

2.12 Non-Shrink Grout

- A. Non-shrink grout is a hydraulic Cement that shall conform to ASTM 1107 and CRD-C-621.

2.13 Hydrophilic Water Stop

- A. Flexible strip construction joint sealant that provides a permanent water seal by expanding upon contact with water, Joint materials shall be CJ-0725-3k or CJ1020-2K as manufactured by the Sika Corporation or approved equal.

PART 3 EXECUTION

3.01 CAST-IN-PLACE CONCRETE

- A. Concrete work shall conform to the Standard Details, the applicable portions of Sections 51 and 90 of the State Standard Specifications, and the Technical Specification section titled “**Concrete Work.**”

3.02 GENERAL CONSTRUCTION

- A. Manholes shall be constructed only when the temperature is above 32° Fahrenheit. All work shall be protected against freezing. Water shall be removed from the excavation and the excavation maintained "dry" during construction of the manhole and during the time required for the concrete or mortar to develop sufficient strength to resist rupture by groundwater pressure. All pipes connected to manholes shall have a joint within 2-feet of the manhole wall.
- B. The subgrade for the manhole base shall be carefully prepared to provide a firm support for the manhole and prevent future settlement of the manhole. Particular care shall be taken with deep manholes and manholes located in wet locations.

- C. Cast-in-place manhole bases shall include waterstops on all plastic pipes cast in the base. The finish of the base shall be smooth, and equivalent to a steel trowel finish.
- D. Manhole inverts shall be formed as shown on the Standard Details, either by laying pipe through and cutting out the top portion before completion of the base of the manhole, or by forming a "U" shaped channel in the concrete base slab. Cut edges of pipe laid through the manhole shall be fully covered by concrete when the manhole invert is complete. The finished invert shall be smooth and true to grade. No mortar or broken pieces of pipe shall be allowed to enter the sewer pipe.
- E. A groove shaped to match the tongue of the first precast concrete riser section of the manhole shall be formed in the base slab. A circular metal form suited to the particular precast manhole manufacturer's joint shall be used to form the groove.
- F. Precast manhole bases shall have the invert slopes constructed to match the plan grades, without additional drop through the manhole, and shall have "O-Ring" or equivalent joints to the sewer pipe.
- G. Except as specified herein, all precast manhole sections shall be set in joint sealing compound. Joint sealing compound components shall be applied in the field. One brush coat of primer shall be applied to the tongue and groove surfaces to be sealed, then the preformed strip of sealing compound shall be pressed firmly to the dry, clean, primed joint surface (groove portion). Precast sections shall be set evenly in a full bed of sealing compound. After the precast sections have been placed, the interior joint surface shall be trimmed smooth with a trowel or sharp tool to remove any excess joint compound projecting into the manhole.
- H. Grade rings may be set with mortar if necessary for adjustment of the final cover elevation. Mortar joints shall not be more than 3/4-inch thick. Excess mortar shall be trimmed flush. The outside of each mortar joint shall be sealed with an approved bituminous sealing compound.
- I. Unless otherwise specified the precast manhole section joints and grade ring shall be sealed with non-shrink grout.

3.03 EARTHWORK

- A. General: Excavation and backfill for precast concrete vaults and meter boxes shall be in accordance with the Technical Specification section titled "**Excavation, Backfill, and Compaction**" and the requirements herein. Excavation limits shall be large enough to accommodate the structure and permit grouting of openings and backfilling operations.
- B. Sub-base:
 - 1. Unless otherwise shown or specified, the bottom of the structure shall be placed on a 12-inch-thick layer of compacted, crushed rock sub-base, graded level and to the proper elevation required for installation and shall conform to the Technical Specification section titled "**Excavation, Backfill, and Compaction.**" Extend crushed rock sub-base a minimum of 12-inches beyond the vault foundation in all directions.
 - 2. Wrap crushed rock base in Engineer approved filter fabric in accordance with the Technical Specification section titled "**Excavation, Backfill, and Compaction.**"

3.04 VAULT INSTALLATION

- A. Vault Wall Openings:
 - 1. Openings or "knockouts" in precast concrete vaults shall be located as shown on the Drawings and shall be sized sufficiently to permit passage of the largest dimension of pipe and/or coupling flange. Wall penetrations shall be as shown.
 - 2. Upon completion of installation, all penetrations or openings in the vault walls that are less than 2-1/2-inches in diameter shall be filled with non-shrink grout, using an epoxy for bonding concrete surfaces, as specified in the Technical Specification section titled "**Concrete Work.**" Pipe or conduits shall be wrapped in hydrophilic water stop prior to the placement of non-shrink grout.
 - 3. Pre-cast pipe openings: Seal pipe penetrations with appropriately sized link seal model "S-316", or equal.
- B. Backfill: After the structure and all appurtenances are in place and approved, backfill shall be placed to the original groundline or to the limits designated on the Plans.
- C. Watertightness: All joints between precast concrete vault sections shall be made watertight. The sealing compound shall be installed according to the manufacturer's recommendations to provide a watertight joint. Pipe and conduit penetrations shall also be watertight.
- D. Installed Elevation: Vaults shall be built up so that the cover is 0.1-foot above the surrounding surface, unless otherwise specified on the Drawings or directed by the Engineer in the field. The Contractor is responsible for placing the cover at the proper elevation and slope where paving is to be installed and shall make all necessary adjustments so that the cover meets these requirements.

3.05 MANHOLE LEAKAGE TESTING

- A. All manholes shall be tested for leakage by filling with water. Leakage shall not be greater than 0.15 gallons per day per square foot of interior surface area. All visible leaks shall be repaired.

3.06 INSTALLATION OF FRAMES AND COVERS NOT IN ROADWAYS

- A. Frames and covers shall be joined to the top of the manhole or structure so that the cover, when placed, will be at the proper elevation and so that no ground or surface water may enter the manhole or structure.
- B. The finish grade at the tops of manholes frames and covers shall be finished so they are 6" above the existing grade.

3.07 INSTALLATION OF FRAMES AND COVERS IN ROADWAYS

- A. Roadways are defined as the paved part of all roads, driveways, and parking areas, public or private, and in addition, the unpaved shoulders of public roads. Concrete collars shall be installed around frames of manholes in roadways. Installation shall be as shown on the Standard Details. Portland cement concrete shall be primed with an asphalt emulsion before it is overlaid with asphalt concrete.
- B. After completion of the manhole, all plugs shall be completely removed from the drain and all loose material shall be removed from the manhole.

- C. The finish grade at the tops of manholes frames and covers shall be flush with the adjacent finished grade of the yard or structure.

3.08 PIPE STUBS

- A. Future connections shall be not more than 2-feet-long and shall be plugged with standard gasketed plugs.

3.09 CLEANOUTS

- A. Cleanouts shall be constructed as shown on the Standard Details. The frame shall be joined to the riser pipe so that groundwater will be prevented from entering the storm drain.

3.10 DROP CONSTRUCTION AT MANHOLES

- A. Drop Construction at manholes shall be installed as shown on the Standard Details. Particular care shall be taken to support the entering pipe on well-compacted material.



PART 1 GENERAL

1.01 SCOPE

- A. This heading covers the furnishing, placement, and compaction of aggregate base material, complete.

1.02 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled “**Submittals.**”
- B. Materials Quality and Source
 - 1. Submit material certificates signed by the material producer and the Contractor certifying that each materials item complies with or exceeds specified requirements.
 - 2. Submit material certificates signed by the material producer and the Contractor, identifying material producer by name, location of material producing plant, and type of plant from which material will be produced and delivered.
- C. Submit Owner inspection requests prior to the following a minimum of seventy-two (72) hours in advance:
 - 1. Aggregate base subgrade.
 - 2. Each completed aggregate base course and prior to placing asphalt concrete pavement.

PART 2 MATERIALS

2.01 AGGREGATE BASE

- A. All aggregate base material shall be Class 2, 3/4-inch maximum, conforming to the requirements of Section 26 of the State Standard Specifications.

PART 3 EXECUTION

3.01 PLACING AGGREGATE BASE

- A. Aggregate base material shall be spread, watered, compacted, and finished in accordance with requirements of Section 26 of the State Standard Specifications and these Technical Specifications.
- B. The Contractor is responsible for coordinating and scheduling all required inspection, sampling, and testing with the Owner provided lab.
- C. Grade approval shall be received from the Owner for subgrade and aggregate base grade.
- D. The subgrade must be firm and unyielding before the base course(s) is placed.
- E. With the Owner’s approval, aggregate base may be used to fill areas of the subgrade that are lower than the grade shown.
- F. The finished aggregate base surface shall not vary more than 0.05 foot from the grade shown.

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- G. The maximum compacted thickness of any one layer shall not exceed 6-inches. The aggregate base shall be compacted to at least 95 percent of the maximum density, as determined by ASTM D 1557, Procedure C. Field density tests shall be performed in accordance with ASTM D 2922, Direct Transmission Method, using the nuclear gauge, or ASTM D 1556, using the sand cone.

- H. Testing interval: One (1) per 250 linear feet of pipeline trench. Where the trench traverses a roadway, a minimum of one (1) field density test shall be performed for each backfill lift per travel lane.

PART 1 GENERAL

1.01 SCOPE

- A. This heading covers the removal, furnishing, placement, and compaction of asphalt concrete paving material, complete.

1.02 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled “**Submittals.**”
- B. Pavement removal plan, including limits, and list of equipment used in this activity.
- C. Mix Design
 - 1. Submit asphalt mix design data prepared within the last year by a certified laboratory acceptable to the Engineer and Owner for each asphalt concrete material type used on the Project.
- D. Materials Quality
 - 1. Submit materials certificates signed by the material producer and the Contractor, certifying that each material item complies with, or exceeds, specified requirements.
- E. Materials Source
 - 1. Submit materials certificates signed by the material producer and the Contractor, identifying material producer by name, location of material producing plant, and type of plant from which material will be produced and delivered.
- F. Submit proposed pavement placement and sequence and schedule.

1.03 INSPECTION AND TESTING

- A. Conformity with Contract Documents
 - 1. Work and materials shall conform to the lines, grades, cross sections, dimensions, and material requirements including tolerances, shown on the Plans and as specified herein.
- B. Advance Notice
 - 1. At least seventy-two (72) hours advance notice shall be given when requesting inspection of Work. No paving or concrete operations shall be permitted except in the presence of a City of Orland Representative.
- C. Access for Inspection and Testing
 - 1. The Contractor and material producer shall, at all times, provide safe access for inspection of the Work by the City of Orland Representative to any shops, production plants, or areas where materials or portions of the Work are in progress. The City of Orland Representative shall be given assistance as necessary for performing tests, and shall be kept apprised of work schedules.
- D. Materials Testing

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1. Unless otherwise specified in the General Conditions or the Special Conditions, the City will provide materials testing in accordance with the current published methods as specified and used by the following agencies:
 - a. American Society for Testing and Materials (ASTM).
 - b. American Association of State Highway and Transportation Officials (AASHTO).
 - c. Test Methods as developed by Materials and Research Department - California Department of Transportation - Division of Highways, Sacramento, California.
- E. Samples
 1. If required by the Owner, in general, samples for testing will be taken by a private laboratory contracted by the City from material at the production plant and/or material delivered to the site of the Work, and such material should be available in ample time to allow for such testing. The City reserves the right to stipulate the number and location of the control tests which will relate to ultimate acceptance of the Work by the Owner.
- F. Equipment
 1. The Contractor shall provide adequate and suitable equipment to meet the requirements of the Contract Documents.

PART 2 MATERIALS

2.01 AGGREGATE BASE

- A. Aggregate base material shall conform to the requirements listed in the Technical Specification titled "**Aggregate Base.**"

2.02 HOT MIX ASPHALT (HMA)

- A. Use asphalt concrete that is Type A, 3/4-inch maximum with gradations per Section 39-2.02B(4)(b) of the State Standard Specifications.

2.03 ASPHALT BINDER

- A. Asphalt Binder shall be PG 64-10 conforming to the requirements of Section 92 of the State Standard Specifications.

2.04 PRIME COAT

- A. Prime coat shall be Grade SC-250 and conform to Section 94 of the State Standard Specifications.

2.05 PAINT BINDER (TACK COAT)

- A. Tack coat shall be an asphaltic emulsion, Grade SS1, and conform to Section 94 of the State Standard Specifications.

2.06 STRIPING

- A. Replacing existing striping, traffic markings, pavement markers in accordance with the applicable portions of the State Standard and the provisions of Section 84 of the State of California Standard Specifications.
- B. Paint color and type shall be as indicated on the Drawings, or if not indicated, shall match as nearly as practical to the existing conditions of the site.

PART 3 EXECUTION

3.01 STRIPING, TRAFFIC MARKINGS, AND PAVEMENT MARKERS – REMOVAL

- A. Prior to placement of asphalt concrete, remove existing striping, traffic markings, and pavement markers in accordance with the Technical Specification titled “**Clearing, Grubbing, and Demolition**” and with the provisions of Section 84-9 of the State of California Standard Specifications.
- B. Striping and pavement markings obliterated by the construction work shall be re-installed using temporary striping or markings prior to the installation of pavement striping and markings.

3.02 PAVEMENT REMOVAL

- A. Saw cutting, removal, and disposal of existing asphalt pavement shall be in accordance with the Technical Specification titled “**Clearing, Grubbing, and Demolition**” and Section 39-3 of the State Standard Specifications.

3.03 PLACING AGGREGATE BASE

- A. Aggregate base shall be placed to the thickness shown on the Plans or to match existing, whichever is greater, in accordance with requirements listed in the Technical Specification titled “**Aggregate Base.**”

3.04 PAINT BINDER (TACK COAT)

- A. Paint binder shall be applied to all vertical surfaces of existing pavement, curbs, gutters, construction joints and to pavement to be resurfaced. Before placing HMA, apply paint binder in one (1) application. Application rates and procedures shall conform to Section 39-2.01C(3)(f) of the State Standard Specifications.

3.05 PRIME COAT

- A. Prime coat shall be applied to all aggregate base surfaces to receive HMA. Apply at least 0.20 gallons of prime coat per square yard of designated area. Do not apply more prime coat than can be absorbed completely by the aggregate base in 24 hours. Before paving, prime coat must cure for 48 hours. Close traffic to areas receiving prime coat. Do not track prime coat onto pavement surfaces beyond the job site.

3.06 PLACING ASPHALT CONCRETE MATERIAL

- A. HMA shall be transported, placed, spread, and compacted in conformance with the provisions of Section 39-2 and Section 39-3 of the State Standard Specifications. HMA shall be spread in one operation with a self-propelled spreader ready for compaction without further shaping.

3.07 STRIPING, TRAFFIC MARKINGS, AND PAVEMENT MARKERS - REPLACEMENT

- A. Following placing of asphalt concrete, replace existing striping, traffic markers, and pavement markers in accordance with the provisions of Section 84-2 of State Standard Specifications, the Owner, and the County Inspector. Unless otherwise required by the Owner and County, all markers shall be the thermoplastic type.
- B. Paint color and type shall match as nearly as practical the existing conditions of the site.

3.08 SURFACE TOLERANCE

- A. Finished grade shall not deviate more than 0.02 foot in elevation from the grade indicated on the Drawings. Slopes shall not vary more than 1/8 inch in 10 feet from the slopes shown on the Plans. Final pavement below the existing surface will not be accepted.
- B. Asphalt pavement placed with deviations exceeding those listed above shall be corrected in accordance with SSPWC subsection 306-13.6.

3.09 REMOVAL OF REJECTED AND UNAUTHORIZED WORK

- A. Work which has been rejected shall be remedied or removed and replaced in an acceptable manner as determined by the Owner. Any work done beyond the lines and grades shown on the Plans or established by the Owner or determined by the Engineer to not be of acceptable material quality, or of acceptable workmanship, or any work done without written authority shall be considered as rejected work. Upon order of the Owner, work shall be remedied, removed, or replaced at no expense to the Owner.

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section covers the construction and installation of chain link fencing, gates, rolling gates, and appurtenances, complete. Fencing shall be 6-foot-high chain link fabric with a continuous top rail and bottom tension wire and three continuous strands of barbed wire above the top rail.
- B. Provide materials, equipment and labor required to execute this work as indicated on the Drawings, specified herein, and necessary to complete the work of this section.

1.02 REFERENCES

- A. The following publications form a part of this specification to the extent referenced.
 - 1. ASTM International (ASTM):
 - a. ASTM A121 Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
 - b. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - c. ASTM A392 Standard Specification for Zinc-Coated Steel Chain Link Fence Fabric.
 - d. ASTM A1011 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 - e. ASTM F552 Standard Terminology Relating to Chain Link Fencing.
 - f. ASTM F567 Standard Practice for Installation of Chain Link Fence.
 - g. ASTM F626, Standard Specification for Fence Fittings.
 - h. ASTM F668 Standard Specification for Poly (Vinyl Chloride) (PVC)-Coated Steel Chain Link Fence Fabric
 - i. ASTM F900 Standard Specification for Industrial and Commercial Swing Gates.
 - j. ASTM F1043 Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
 - k. ASTM F1083 Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
 - 2. American Institute of Steel Construction (AISC):

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- a. "Specification for the Design, Fabrication and Erection of Structural Steel for buildings," eighth edition.
3. American Welding Society (AWS):
 - a. AWS D1.0 "Code for Arc and Gas Welding in building Construction."
 - b. "Structural Welding Code."
4. CLFMI – Chain Link Fence Manufacturers Institute.
5. Pacific Gas & Electric (PG&E) Standards.
6. State and local building codes, together with applicable state and local laws.
7. Standard Specifications for Public Works Construction (SSPWC):
 - a. Standard Specifications for Public Works Construction.
 - b. Standard Plans for Public Works Construction.

1.03 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled "**Submittals.**"
- B. Shop Drawings:
 1. Submit drawings of fabricated items. The following shall be included in the submittal:
 - a. Describe all fabricated items and show all dimensions, sizes, foundations, finishes, fasteners and welds, and relationship of work to adjoining construction.
 - b. Reference all construction materials by ASTM designations and grades. Catalog work sheets showing illustrated cuts of items to be furnished, including scale details, foundations, dimensions, and materials may be submitted for standard manufactured items.
 2. Submit placement or erection drawings which indicate locations and elevations of fabricated items, including foundations. Reproduction of Contract Documents will not be accepted for this purpose. Verify all dimensions to ensure proper fit of all fabricated items.
- C. Shop and field repair procedures and materials.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM F567, Product Manual of CLFMI, and SSPWC.
- B. All materials shall be new. Old, improperly galvanized, coated, or damaged materials are not permitted.

1.05 WARRANTY

- A. Fence, gate, and accessories shall be the product of a single manufacturer, and the manufacturer's warranty shall be for the entire fencing system.

PART 2 PRODUCTS

2.01 GENERAL

- A. Except as otherwise indicated in this Section of the Specifications or shown on the Drawings, materials shall comply with the Standard Specifications for Public Works Construction (SSPWC).
- B. All steel and iron parts shall be hot-dip galvanized after fabrication or weaving. The zinc used for coating shall conform to ASTM B6 Standard Specifications for slab zinc. The weight of zinc coating shall be not less than 1.2 ounces per square foot of actual surface covered when tested in accordance with the method described in ASTM A90.

2.02 CHAIN LINK FENCE FABRIC

- A. Chain link fence fabric shall be galvanized steel fabric composed of individual wire pickets helically wound and interwoven, No. 9 gage conforming to the requirements of ASTM A392, Class 1 & CLFMI Product Manual.
- B. Galvanize after weaving.
- C. Fence Height: 72-inches.
- D. Pattern: 2-inch diamond mesh.
- E. Finish: Top and bottom selvages shall have a twisted and barbed finish. Barbing shall be done by cutting the wire on the bias.
- F. Barbed Wire: Three strands at top of fence and gates per Drawings.

2.03 BARBED WIRE

- A. Barbed wire shall be in conformance with ASTM A121, Class 1. It shall consist of two strands of 12-1/2 gage galvanized steel wire, twisted with 4-point, 14 gage barbs spaced not more than 5-inches apart.
- B. Extension arms for barbed wire shall be of a type that can be attached to the tops of the posts and carry three wires at approximately 5-1/2-inches center in a plane approximately 45 degrees from the vertical, inclined as shown on the Drawings or as directed by the Engineer; and which shall also act as a weather cap and allow for passage of top rail where applicable.

2.04 POSTS AND RAILS

- A. General:
 - 1. Strength and Stiffness Requirements: ASTM F1043, Light Industrial Fence, except as modified in this Section.
 - 2. Steel Pipe: ASTM F1083, Schedule 40.

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3. Roll-Formed Steel Shapes: Roll-formed from ASTM A1011, Grade 45, steel.
 4. Lengths: Manufacturer's standard with allowance for minimum embedment below finished grade of 33-inches or as shown on Drawings.
 5. Protective Coatings:
 - a. Galvanized Coating: ASTM F1043, Type A external and internal coating.
- B. Line Posts:
1. Steel Pipe:
 - a. Outside Diameter: 2.375-inches.
 - b. Weight: 3.65 pounds per foot (10% average tolerance).
- C. End, Corner, Angle, and Pull Posts:
1. Steel Pipe:
 - a. Outside Diameter: 2.875-inches.
 - b. Weight: 5.8 pounds per foot (10% average tolerance).
- D. Gate Posts:
1. ASTM F900.
 2. Roll-formed steel shapes may be substituted for steel pipe posts for gate leaf widths up to 6 feet and fabric heights up to 8 feet.
 - a. Outside Dimensions: 4.0-inches.
 - b. Weight: 9.11 pounds per foot.
- E. Frames and Stiffeners for Gates:
1. ASTM F900.
 2. Steel Pipe:
 - a. Frame Pipe Outside Diameter: 1.900 inches, 2.72 pounds per foot.
 - b. Stiffener Pipe Outside Diameter: 1.660 inches, 1.806 pounds per foot.
- F. Top, brace, and Intermediate Rails
1. Steel pipe or roll-formed steel C shapes.
 2. Steel Pipe:
 - a. Outside Diameter: 1.66-inches.

- b. Weight: 1.806 pounds per foot.
- 3. Roll-Formed Steel C Shapes:
 - a. Outside Dimensions: 1.625-inches by 1.625-inches.
 - b. Weight: 1.4 pounds per foot.

2.05 GATES

A. General

- 1. Gate Operation: Opened and closed easily by one person.
- 2. Welded Steel Joints: ground smooth and coated painted with zinc-based paint.
- 3. Chain Link Fabric: Same fabric as chain link fence. Attached securely to gate frame at intervals not exceeding 15-inches.
- 4. Frame Bracing: Use galvanized steel pipe center posts, steel gusset plates (4-inch long by 3/8-inch-thick) and steel truss rods with galvanized turn buckles as hereinbefore specified.

B. Swing Gates:

- 1. ASTM F900.
- 2. Hinges:
 - a. Furnished with large bearing surfaces for clamping in position.
 - b. Designed to swing either 180 outward, 180 degrees inward, or 90 degrees in or out, as shown, and not twist or turn under action of gate.
- 3. Latches: Plunger bar arranged to engage stop, except single gates of openings less than 10 feet wide may each have forked latch.
- 4. Gate Stops: Mushroom type or flush plate with anchors, suitable for setting in concrete.
- 5. Locking Device and Padlock Eyes: Integral part of latch, requiring one padlock for locking both until manually released.
- 6. Unless otherwise shown or specified, the Owner will provide a padlock and set of keys for each gate.

C. Roller Gates:

- 1. Operator conform to UL 235 Class III.
- 2. Conform to ASTM F1184 Standard Specification for Industrial and Commercial Horizontal Slide Gates, Type III rolling gate, Class 2 with steel frame supporting pipe track at the trailing edge and an on-grade roller support at the leading edge of the gate.

D. The gate widths shall be as shown on the Drawings.

2.06 FABRIC TIES

- A. 11-gage galvanized steel or 6-gage aluminum tie wires.

2.07 TRUSS ROD ASSEMBLY

- A. 3/8-inch-diameter galvanized steel rod complete with turn buckles and attachments to posts and frames.

2.08 TENSION BARS

- A. One-piece galvanized high carbon steel bars at least 3/16 inch by 3/4 inch and equal in length to full height of fabric.

2.09 TENSION WIRE

- A. No. 7 gage zinc-coated steel marcelled tension wire conforming to ASTM A824, Type II, Class 2.

2.10 FENCE FITTINGS

- A. General: In conformance with ASTM F626, except as modified in this Section.
- B. Post and Line Caps: Equip all pipe posts with a galvanized steel weather-resistant cap that fits securely over the posts, with an apron around the outside of the post. Designed to accommodate passage of top rail through cap, where top rail required.
- C. Tension and Brace Bands: No exceptions to ASTM F626.

2.11 CONCRETE

- A. Concrete mix shall be Site Concrete per the Technical Specification titled “Concrete.”

2.12 FINISHES

- A. Fabric
 - 1. Galvanized to ASTM A392 Class 2; nominal 2 oz/ft² coating. Fabric coating shall be “Galvanized after Weaving (GAW).” Wire shall be zinc-coated by either the hot-dip or electrolytic process.
- B. Frame and Fittings
 - 1. Hot-Dip galvanized to ASTM F1083, nominal 2 oz/ft² coating. Framework material design shall meet the requirements of Group IA of Table 2 of ASTM F1043.
- C. Hardware
 - 1. Galvanized to ASTM A153; nominal 2 oz/ft² coating.
- D. Accessories
 - 1. Same finish as hardware.
- E. Gates
 - 1. Shall be same as those specified for the fences.

F. Not Allowed

1. Galvinal, Bezinal, or Galfan coatings, which combine zinc and aluminum, shall not be used.

2.13 GALVANIZING REPAIR MATERIAL

A. Hot repair compound conforming to Federal Specification O-G-93, "Galvalloy" by Metalloy Products Co., Los Angeles, California or "Re-Galv" by Galvweld applied as recommended by the manufacturer.

2.14 GROUNDING

- A. Where 69-kilovolt and above power transmission lines cross or are adjacent to chain link, stock, barbed wire, and wildlife fences, including gates, the fences shall be grounded as shown on the Drawings, and in conformance with the standards of Pacific Gas and Electric Company.
- B. The Contractor shall furnish and install all the materials required to complete a low-impedance grounding system for these fences.
- C. The grounding systems indicated on the Drawings supplement the requirements of this Section. The conductors used for grounding purposes shall be sized as shown on the Drawings.

PART 3 EXECUTION

3.01 CONSTRUCTION METHODS

A. Construction methods shall comply with all applicable sections of the Standard Specifications for Public Works Construction (SSPWC), latest edition, unless noted otherwise herein.

3.02 EXAMINATION

A. Examine the areas and conditions under which Work of this section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.03 PREPARATION

- A. Establish locations of fence lines, gates, and terminal posts.
- B. All trees, brush and other obstacles which would interfere with the proper erection of fencing shall be removed and disposed of in advance of fence erection.

3.04 INSTALLATION

- A. Install chain link fences and gates in accordance with ASTM F 567, except as modified in this Section, and in accordance with fence manufacturer's recommendations, as approved by Engineer. Erect fencing in straight lines between angle points. Finished fence shall be in alignment, taut, and solid at all points.
- B. Provide all necessary hardware for a complete fence and gate installation.

3.05 POST SETTING

- A. Driven posts are not acceptable.
- B. Line posts shall be spaced at not more than 10-foot intervals, measured from center to center of the posts and generally parallel to the ground slope. Posts shall be set plumb and shall be centered in concrete foundation.
- C. Changes in the fence lines, where the horizontal angle is 15 degrees or more, shall be considered as corners and corner posts shall be installed.
- D. Wherever practical, at the discretion of the Engineer, all changes in the right-of-way width of 15 feet or less shall be adjusted with two 15 degree bends to eliminate the need for extra corner posts.
- E. Excavating and Backfilling: Neatly and accurately excavate foundation holes for posts as indicated. Compact subgrade or any loose material. Solidly and firmly backfill around completed concrete foundations with excavated earth materials to finish grade or to proper elevation, as necessary for required paving as applicable.
- F. Set posts in the ground with minimum embedment below finished grade as shown on Drawings and with top rail at proper height above finished grade. Brace posts, as necessary, to maintain correct position and plumbness until concrete sets.
- G. Backfill post holes in the ground with concrete to 2-inches above finished grade. Before concrete sets, crown and finish top of concrete to readily shed water.
- H. Fence posts set in the top of a concrete wall shall be located in the center of the wall.
- I. Set fence post in concrete walls by either casting fence posts in place, casting blockouts in the top of the wall, or coring the concrete in the top of the wall.
 - 1. Cast in place posts: Set posts plumb. Secure posts to prevent movement during concrete placement. Embed posts 12-inches deep in concrete.
 - 2. Cast in place blockouts: Place blockouts 12-inches deep and 4 inches in diameter.
 - 3. Coring: Core holes 4 inches in diameter and 12-inches deep.
- J. Posts set in breakout holes or core holes shall be grouted in place with Type 1 grout in accordance with the requirements of Non-Shrink Grout.

3.06 BRACING

- A. Brace gate and corner posts diagonally to adjacent line posts to ensure stability.

3.07 TOP RAILS

- A. Extend through post eye-top caps and attach ends to corner, gate, and/or terminal (end) posts.
- B. Install top rail sleeves with springs at 100-foot maximum spacing to permit expansion in rail.

3.08 CHAIN LINK FABRIC

- A. Do not install fabric until concrete has cured minimum 7 days.
- B. Install fabric with twisted and barbed selvage at top and bottom.
- C. Install tension wire at bottom fabric before stretching fabric or attach to each post with ties. The fabric shall be installed so that the top edge projects over the top rail or tension wire of the fence and the bottom tension wire or bottom rail by 3-inches. The bottom of the fabric shall extend to within 2-inches of the natural ground or final grade. High points of ground shall be excavated to clear the bottom of the fabric and depression shall be filled and compacted to within 2-inches of the bottom of fabric.
- D. The fabric shall be fastened to line posts with galvanized tie wires or post clips and to tension wires with tie wires or hog rings. These fasteners shall be spaced approximately 12-inches on center for line posts and at 12-inches on center for tension wires.
- E. Stretch fabric between pull posts or at intervals of 100-feet maximum, whichever is less.

3.09 EXTENSION ARMS

- A. Set at 45 degree angle with vertical on inside of fence on all posts. On gates and in line posts adjacent to gates, set extension arms in vertical position to avoid interference with gate operation.

3.10 BARBED WIRE

- A. Stretch taut three lines and securely fasten within slots on extension arms by means of heavy galvanized wire pins.

3.11 GATES

- A. Properly hang or set gate(s) in plumb and level position for full opening without interference and adjust the hardware for smooth and trouble-free operation from open and closed positions; complete with heavy center drop and cane bolt, hold-back sleeves properly located and concreted in place as indicated on the Drawings. Concrete foundation for sleeve shall be domed or sloped at top to shed water and with edges at finish grade or adjoining ground or paved surfaces.
- B. Set gate stops in concrete to engage center drop rod plunger bar.

3.12 MISCELLANEOUS

- A. Use U-shaped tie wires, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least two full turns.
- B. Bend ends of wire to minimize hazards to persons and clothing.
- C. Fasteners:
 - 1. Install galvanized nuts for tension band and hardware bolts on side of fence opposite fabric side.
 - 2. Peen the ends of bolts to prevent removal of the nuts.

3.13 REPAIRS

- A. Repair fencing, post, and other coatings damaged in the shop or during field erection using an Engineer approved hot-applied repair compound applied in accordance with repair compound manufacturer's recommendations at no additional cost to the Owner.

3.14 GROUNDING

- A. Ground shall be installed as shown on the Drawings, Division 16, and Pacific Gas and Electric Company Standards.

3.15 FIELD QUALITY CONTROL

- A. Gate Tests: Prior to acceptance of installed gates, demonstrate proper operation of gates.
- B. Maximum Variation from Plumb – 1/4-inch (6 mm).
- C. Maximum Offset from True Position – 1-inch (25 mm).

PART 1 GENERAL

1.01 SCOPE

A. This heading covers concrete work, complete.

1.02 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. American Concrete Institute International (ACI)
 - a. ACI 318 Building Code Requirements for Structural Concrete and Commentary
 - b. ACI 117 Specifications for Tolerances for Concrete Construction and Materials and Commentary
 - c. ACI 121R Guide for Concrete Construction Quality Systems in Conformance with ISO 9001
 - d. ACI 211.5R Guide for Submittal of Concrete Proportions
 - e. ACI 229R Controlled Low Strength Materials
 - f. ACI 301 Specifications for Structural Concrete
 - g. ACI 301M Metric Specifications for Structural Concrete
 - h. ACI 302.1R Guide for Concrete Floor and Slab Construction
 - i. ACI 304.2R Guide to Placing Concrete by Pumping Methods
 - j. ACI 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete
 - k. ACI 305.1 Specification for Hot Weather Concreting
 - l. ACI 305R Guide to Hot Weather Concreting
 - m. ACI 306.1 Standard Specification for Cold Weather Concreting
 - n. ACI 306R Guide to Cold Weather Concreting
 - o. ACI 308.1 Specification for Curing Concrete
 - p. ACI 347R Guide to Formwork for Concrete
2. American Hardboard Association (AHA)
 - a. AHA A135.4 Basic Hardboard

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- 3. ASTM International (ASTM)
 - a. ASTM A184/A184M Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
 - b. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - c. ASTM A706/A706M Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
 - d. ASTM A934/A934M Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
 - e. ASTM A1035/A1035M Standard Specification for Deformed and Plain, Low-carbon, Chromium, Steel Bars for Concrete Reinforcement
 - f. ASTM A1064/A1064M Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 - g. ASTM C31/C31M Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - h. ASTM C33/C33M Standard Specification for Concrete Aggregates
 - i. ASTM C39/C39M Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - j. ASTM C42/C42M Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
 - k. ASTM C94/C94M Standard Specification for Ready-Mixed Concrete
 - l. ASTM C143/C143M Standard Test Method for Slump of Hydraulic-Cement Concrete
 - m. ASTM C150/C150M Standard Specification for Portland Cement
 - n. ASTM C172/C172M Standard Practice for Sampling Freshly Mixed Concrete
 - o. ASTM C260/C260M Standard Specification for Air-Entraining Admixtures for Concrete
 - p. ASTM C494/C494M Standard Specification for Chemical Admixtures for Concrete
 - q. ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

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- r. ASTM C1077 Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
- s. ASTM C1107/C1107M Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- t. ASTM C1602/C1602M Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
- u. ASTM D4832 Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders
- v. ASTM D5084 Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
- w. ASTM D6023 Standard Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM)
- x. ASTM D6103/D6103M Standard Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)

- 4. Concrete Reinforcing Steel Institute (CRSI)
 - a. CRSI 10MSP Manual of Standard Practice
 - b. CRSI RB4.1 Supports for Reinforcement Used in Concrete

- 5. NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)
 - a. NIST PS 1 DOC Voluntary Product Standard PS 1-07, Structural Plywood

- 6. U.S. ARMY CORPS OF ENGINEERS (USACE)
 - a. COE CRD-C 621 Specification for Structural Non-Shrink Grout

1.03 SUBMITTALS

- A. Submit in accordance with Technical Specification section titled “**Submittals**”.

- B. Concrete Placement Drawings
 - 1. Composite concrete placement drawings for each individual placement shall be submitted, indicating location and sizes of pipe sleeves, conduits, inserts, reglets, anchor bolts, openings, recesses, construction joints, expansion joints, and other embedded items. Placement drawings shall be coordinated with drawings. Placement drawings shall show where each mix will be used.

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2. Each drawing shall show only one placement. Match-lines shall reference adjoining placement drawings, and an index shall be provided on each sheet showing the location of the placement in the overall structure.
 3. The Contractor shall submit a copy of the sequence of placement in advance of actual placement.
- C. Concrete Hot and Cold Weather Plan
1. Plan for hot weather concreting procedures; including procedures for transporting, placing, protecting, curing, and monitoring temperature of concrete during hot weather.
 2. Plan for cold weather concreting procedures, including procedures for transporting, placing, protecting, curing, and monitoring temperature of concrete during cold weather. Include procedures to be implemented upon abrupt changes in weather conditions or equipment failures. Include procedures for protecting the subgrade from frost, and for preventing the accumulation of ice or snow on reinforcement or forms prior to placement.
- D. Mix design with proof of design by laboratory 7-day and 28-day compressive tests, or test reports of 7-day and 28-day compressive tests of the mix where the same mix was used on two previous projects, shall be submitted in writing for review by the Engineer at least 30 days before placing of any concrete. Mixtures shall be proportioned in accordance with ACI 211.1. The submittal of mixture proportions and supporting information shall follow the guidelines given in ACI 211.5R. The submittal shall include the laboratory mix data used for selection of mixture proportions.
- E. Certificate of Compliance
1. Certificate that cement used in the concrete complies with ASTM C150 and these specifications shall be submitted.
 2. Certificate that fly ash conforms to ASTM C618, Class F shall be submitted.
 3. Aggregates: Certificate of compliance with ASTM C33 shall be provided. Weathering region limits of coarse aggregates: severe, moderate, or negligible shall be stated. Basis of determining that potential reactivity is negligible shall be stated.
 4. Concrete admixtures: Manufacturer's certificate of compliance with these specifications shall be provided.
 5. Nonshrink Grout: Manufacturer's certificate of compliance with these specifications and specific instructions for use shall be provided.
 6. Synthetic Fibers: Manufacturer's certificate of compliance with these specifications and specific instructions for use shall be provided.
- F. Epoxy Bonding Compound: Manufacturer's specific instructions for use shall be provided.
- G. Statement of Qualifications:
1. Mix designer.
 2. Batch plant.
 3. Contractor's resident superintendent for concrete placement.
- H. Ready Mix Concrete

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1. Delivery tickets or weighmasters certificate per ASTM C94, including weights of cement and each size aggregate, volume of water in the aggregate, and volume of water added at the plant shall be provided. The volume of water added on the job shall be written on the ticket or certificate.

I. Reinforcing Steel Drawings

1. Submit detail drawings prepared in accordance with the contract drawings and ACI 315.
2. Submit bar placement drawings, bar bending diagrams and bar lists showing details for bar supports, splices, dowels, ties, temporary support steel, and other information necessary for complete fabrication and placement. Detailing shall comply with ACI 315.
3. Placement drawings shall show bars in their correct positions.
4. Placement drawings shall include information necessary for complete fabrication and placement of reinforcing steel, bar supports, splices, dowels, ties, and temporary support steel.
5. Submit bending lists and placing drawings for all reinforcing steel. Each bending list submitted shall be complete, including corner bars as required. Furnishing such lists shall not be construed that the lists will be reviewed for accuracy. The contractor shall be wholly and completely responsible for the accuracy of the lists and for furnishing and placing reinforcing steel in accord with the details shown on the plans and as may be specified elsewhere in the contract documents.

J. Reinforcing steel Mill certificates

1. Submit mill test certificates and manufacturer's certification identifying chemical and physical analyses of each load of reinforcing steel delivered.
 - A. For each heat of reinforcing bars or reinforcing steel procured, the contractor shall submit a certified copy of the mill test showing the physical and chemical analysis.

1.04 QUALITY ASSURANCE AND TESTING

- A. Mix designer shall be a licensed professional engineer registered in the State of California or a Caltrans approved concrete mix designer, with a minimum of 5 years of experience in the design of concrete mixes.
- B. Batch plant shall be currently certified by the National Ready Mixed Concrete Association.
- C. During progress of the work, compression tests shall be made at the discretion of the Engineer of samples of the concrete using the molded cylinder method in accordance with ASTM C31 and ASTM C39. Unit weight, slump, air content, and temperature shall also be made at the discretion of the Engineer in accordance with ASTM C138, ASTM C143, ASTM C231, and ASTM C1064, respectively. Materials for the samples will be furnished at the expense of the Contractor. Testing will be done by the Owner or authorized laboratory at the expense of the Owner.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Identification of Reinforcing Steel:

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1. All steel shall have the manufacturer's mill marking rolled into the bar which shall indicate the producer, size, type, and grade. All reinforcing shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.
 2. Tagging and identification requirements shall be the same for both shop and field fabricated reinforcing steel.
 3. Unidentified reinforcing steel will be rejected.
- B. Storage and Protection:
1. Reinforcing steel shall be stored off the ground and protected from oil or other deleterious materials. Reinforcement shall be maintained, cleaned, and protected from moisture until delivered.
- C. Upon delivery the reinforcement shall be thoroughly cleaned of dirt, loose mill scale, flaky rust and other substances that may prevent proper bonding with concrete.

PART 2 MATERIALS

2.01 PORTLAND CEMENT

- A. Portland cement shall be Type II or Type V, low alkali and conform to ASTM Specification C150. All cement shall be furnished from one source and protected from moisture until used.

2.02 FLY ASH

- A. Fly ash shall conform to ASTM C 618, Class F.
- B. Fly ash shall be stored and handled as required for Portland cement and shall be protected from moisture.

2.03 CONCRETE AGGREGATES

- A. General
1. Concrete Aggregate shall conform to ASTM Specification C33. The sieves used in Sieve Analysis shall be square mesh wire cloth. Both coarse and fine aggregate shall be tested for soundness by ASTM Method C88 when in the judgment of the Engineer such tests are necessary to determine the quality of the materials.
 2. Fine Aggregate shall consist of natural sand having hard, strong and durable particles. It shall not contain more than 2 percent by weight of clay, shale, schist, alkali, or other deleterious substances. The grading of fine aggregate shall range uniformly from coarse to fine.
 3. Coarse Aggregate shall consist of clean, hard, sound crushed rock or washed gravel. It shall not contain more than 2 percent by weight of clay, shale, schist, alkali, or other deleterious substances. The grading of coarse aggregate shall range uniformly from coarse to fine.
 4. Storage: Fine and coarse aggregate shall be stored and measured separately. Aggregate shall be stored on the job so that various sizes do not become intermixed. They shall be protected from contamination with dust, dirt, or other foreign materials.

5. Moisture Content of aggregate shall be such that no visible separation of moisture and aggregate will take place during transportation from the proportioning plant to the point of mixing. Aggregate containing excess moisture shall be stockpiled prior to use and sufficiently dried.
6. Variations in moisture content shall not exceed one percent of the weight of the aggregate in a saturated surface dry condition. Variations in specific gravity of any group of sizes shall not exceed one percent. Variations in grading of separate groups of sizes of aggregate shall not exceed 5 percent. Variations exceeding these maximums shall constitute cause for delaying the use of the materials until batch weights and mixing water can be adjusted.
7. Aggregate Size: The primary size of aggregate specified and used on any project shall be the maximum consistent with the dimensions and form of the section being placed, the location and spacing of the reinforcing bars, and with the method of compaction, but shall not be less than 3/4-inch.

2.04 WATER AND ICE

- A. Water and ice shall be clean and free of oil, acid, alkali, organic matter or other deleterious substances and conform to applicable provisions of ASTM C1602.

2.05 CURING COMPOUND

- A. General
 1. Curing compound shall conform to ASTM C 309, Type 2, Class B, and shall be compatible with the local air quality management district's requirements and the required finishes and coatings. Compounds shall have a fugitive dye.
- B. Manufacturers
 1. Curing compound shall be Kure-N-Seal manufactured by BASF or Super Diamond Clear 350 manufactured by Euclid Chemical Co.

2.06 REINFORCING STEEL

- A. General Requirements:
 1. Reinforcing steel shall be new material conforming to ASTM A 615, Grade 60, and shall be fabricated in accord with the current edition of the manual of standard practice, published by the concrete reinforcing steel institute.
 - A. Reinforcing steel shall be bent while cold.
 - B. Submit manufacturer's certified test report of reinforcement.
- B. Delivery:
 1. Reinforcing steel shall be delivered to the site bundled and with identifying tags.

2.07 WELDED WIRE FABRIC

- A. Welded wire fabric shall conform to ASTM A 1064.

2.08 TIE WIRE

- A. Tie wire shall be 16 gage minimum, black, soft annealed.

2.09 BAR SUPPORTS

- A. Bar supports in beams and slabs exposed to view after form stripping shall be non-metallic and of sufficient strength to properly secure the reinforcement bars during the placement of concrete. Concrete supports shall be used for reinforcing in concrete placed on grade.

2.10 FABRICATION

- A. Fabricate and place reinforcement in structures conforming to approved bending diagrams, placing lists, and placing drawings.
- B. Cut and bend reinforcement in accordance with approved fabrication details. Should the contractor elect to fabricate on the job, the contractor shall do so in a manner and with equipment suited to the purpose and approved by the engineer.

2.11 ADMIXTURES

- A. General
 - 1. Admixtures shall be used only where specifically required or where written approval has been granted by the Engineer.
 - 2. Furnish each admixture from a single manufacturer.
- B. Air-Entraining Admixture
 - 1. Concrete may contain an air-entraining admixture which shall conform to ASTM C260, except it shall be nontoxic after 30 days and shall contain no chlorides.
 - 2. Admixture shall be Grace Construction Products, Master Builders, Sika, or equal.
- C. Water-Reducing Admixture
 - 1. Concrete may contain a water-reducing admixture which shall conform to ASTM C494, Type A or Type D, and shall be compatible with the air-entraining admixture. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations.
 - 2. Admixtures shall be Grace Construction Products, Master Builders Pozzoloth polymer-type normal setting, Sika, or equal.
- D. Accelerant
 - 1. Concrete for thrust blocks may contain an accelerant which shall conform to ASTM C 494, Type C or Type E, and shall be compatible with any other admixtures used. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations.
 - 2. Admixtures shall be Grace Construction Products, Master Builders, Sika, or equal.
- E. Admixture Restrictions

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1. Accelerating water-reducing admixtures or any other type of admixture that contains chlorides or other corrosive elements shall not be used in any concrete.

2.12 NON-SETTLING GROUT

- A. Non-Settling grout mortar shall be a non-shrink, non-metallic cementitious grout, and shall meet the requirements of ASTM C1107.
- B. Acceptable Grout shall be UPCON High Flow; Master Flow 713; or equal. All components shall be inorganic.

2.13 ORDINARY TYPE GROUT (DRY PACK)

- A. Ordinary type grout shall consist of one-part Portland cement to two parts sand (100 percent passing a No. 8 sieve). Sufficient water shall be added to produce damp formable consistency.

2.14 BONDING COMPOUND

- A. Portland Cement
 1. Neat Portland cement or a blend of neat Portland cement and fine aggregate filler with water to a creamy consistency.
- B. Epoxy
 1. Manufacturer's certifications as to suitability of product to meet job requirements with regard to surface, pot life, set time, vertical or horizontal application, and forming restrictions shall be provided.
 2. Bonding compound shall be Concessive 1001 LPL as manufactured by Adhesive Engineering Company, or Sikadur Hi-Mod (Sikastix 370) as manufactured by Sika Chemical Corporation.

2.15 CONCRETE MIX DESIGN

- A. General
 1. Concrete mix design shall conform to ASTM C94 and ACI 318, except as modified by these specifications.
- B. Provide the following conventional concrete for use in the work:
 1. Structural concrete: 4,500 psi at 28 days, for general use in structural reinforced concrete elements (Tank ring-wall foundation, column foundations, electrical gear shade structure foundation, pump foundations, pipe collars, and pipe support foundations). Minimum cementitious content for structural concrete shall be 615 lbs per cubic yard.
 2. Fiber-Reinforced Concrete: 4,000 psi at 28 days, to be used for canal concrete lining.
 3. Class A (civil site concrete): 6 sacks of cement per cubic yard of concrete with a minimum compressive strength of 3,000 psi at 28 days, to be used for civil site works (All curbing, sidewalks, manhole bases, thrust blocks, and structures unless specified elsewhere., etc.)

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4. Class B (street surface improvements): 5 sacks of cement per cubic yard of concrete with a minimum compressive strength of 2,500 psi at 28 days, to be used for fence posts, guard posts etc.
 5. Class C: 4.2 sacks of cement per cubic yard of concrete with a minimum compressive strength of 2,000 psi at 28 days, to be used for fill for structure foundations, cradles, supports across pipe trenches, anchors and miscellaneous unreinforced
 6. Where unreinforced concrete class is not shown or specified, Class A concrete shall be used.
- C. Fly Ash
1. Fly ash shall not be used in the mix as a partial substitute for cement, unless specifically requested in the mix requirements. Class A, B, and C concrete shall contain 20 to 25 percent fly ash, by weight of total cementitious material unless otherwise approved by the Engineer.
- D. Air Content
1. Air content as determined by ASTM C231 shall be 4% +/- 1%.
- E. Water-Cement Ratio
1. Maximum water-cement ratio shall not exceed 0.44 by weight.
- F. Slump
1. Slump shall be measured in accordance with ASTM C143. Slump shall be as follows:
 - a. Slab on grade or heavy sections wider (in plan view) than 3 feet.
 - b. Three inches maximum.
 2. Footings, walls, suspended slabs, beams, and columns:
 - a. Four inches maximum.
 3. Concrete shall be proportioned and produced to have a maximum slump as shown. A tolerance of up to 1-inch above the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated.
- G. Aggregate Size
1. Aggregate shall be 1-inch maximum for all structural and site work concrete and 3/4-inch for fiber reinforced concrete per ASTM C33 gradations.

2.16 PUMPED CONCRETE DESIGN MIX

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

2.17 DURABILITY

- A. The temperature of the concrete as delivered must not exceed 85°F.

2.18 WORKABILITY

- A. General

- 1. Concrete shall be of such consistency and composition that it can be worked readily into the forms and around the reinforcement without excessive spading and without permitting the materials to segregate or free water to collect on the surface. The proportions shall be adjusted to secure a plastic, cohesive mixture, and one which is within the specified slump range.

- B. Aggregate

- 1. To avoid unnecessary changes in consistency, aggregate shall be obtained from a source with uniform quality, moisture content, and grading. Materials shall be handled in such a manner that variations in moisture content will not interfere with production of concrete of the specified degree of uniformity.

2.19 EXPANSION JOINT FILLER

- A. Expansion joint filler shall be of the preformed non-extruding type and shall conform to ASTM D545, Type V, bituminous fiber, and shall be the full depth of the abutting concrete.

- B. Unless otherwise shown or specified, premolded expansion joint filler shall be 1/2-inch thick for curbs and 1/2-inch thick for sidewalks.

2.20 CONCRETE FORMS

- A. Plywood PS-1, Grade B

- 1. Form Release Agent Non staining form oil or form release agent that is not deleterious affect the concrete surface nor impair subsequent applications of release agents and shall have a red or white dye.

2.21 READY-MIX CONCRETE

- A. Provide concrete that meets the requirements of ASTM C94/C94M. Ready-mixed concrete manufacturer must provide duplicate delivery tickets with each load of concrete delivered. Provide delivery tickets with the following information in addition to that required by ASTM C94/C94M:

- 1. Type and brand cement.
- 2. Cement and supplementary cementitious materials content in pounds of cement (or supplementary) per cubic yard of concrete.
- 3. Maximum size of aggregate.
- 4. Amount and brand name of admixtures.
- 5. Total water content expressed by water cementitious material ratio and by gallons.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.
- B. Do not begin reinforcement placement until the foundations/substrates have been properly constructed.
- C. Check field dimensions before beginning of the installation. Notify the engineer immediately of any discrepancies from the approved drawings.

3.02 REINFORCEMENT PLACING

- A. General:
 - 1. Reinforcing steel shall be placed in accordance with ACI 301 and ACI 318 and the current edition of Recommended Practice for Placing Reinforcing Bars, published by the CRSI.
 - 2. Secure the reinforcement in position and ensure inspection and approval before placing concrete.
 - 3. When concrete is placed, ensure reinforcement is free of materials deleterious to bond. Reinforcement with rust, mill scale, or a combination of both will be considered satisfactory, provided minimum nominal dimension, nominal weight, and minimum average height of deformations of a hand-wire-brushed test specimen are not less than applicable ASTM specifications' requirements.
 - 4. For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, support bars or welded wire reinforcement on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.
 - 5. For slabs other than on grade, supports for which any portion is less than 1 inch from concrete surfaces that are exposed to view or to be painted must be of precast concrete units, plastic-coated steel, or stainless-steel protected bar supports. Precast concrete units must be wedge shaped, not larger than 3-1/2- by 3-1/2-inches, and of thickness equal to that indicated for concrete protection of reinforcement. Provide precast units that have cast-in galvanized tie wire hooked for anchorage and blend with concrete surfaces after finishing is completed.
 - 6. Provide reinforcement that is supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:
 - a. Provide supports for reinforcing bars that are sufficient in number and have sufficient strength to carry the reinforcement they support, and in accordance with ACI 301 and CRSI 10MSP. Do not use supports to support runways for concrete conveying equipment and similar construction loads.
 - b. Equip supports on ground and similar surfaces with sand-plates.
 - c. Support welded wire reinforcement as required for reinforcing bars.

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- d. Secure reinforcements to supports by means of tie wire. Wire must be black, soft iron wire, not less than 16 gage.
 - e. Reinforcement must be accurately placed, securely tied at intersections, and held in position during placing of concrete by spacers, chairs, or other approved supports. Point wire-tie ends away from the form. Unless otherwise indicated, numbers, type, and spacing of supports must conform to the Contract Documents.
7. Place and maintain barricades and safety signs as needed for safety and as required by the Technical Specification **“Traffic Control”**.
- B. Cleaning:
- 1. Reinforcing steel, before being positioned, shall be free from loose mill and rust scale and from any coatings that may destroy or reduce the bond. Where there is delay in depositing concrete, reinforcement steel shall be cleaned by abrasive sandblasting to remove mortar, oil, dirt, excessive mill scale, scabby rust, and coatings of any character that would destroy or reduce the bonding capability.
- C. Bending:
- 1. Reinforcing steel shall not be straightened or reshaped in a manner that will injure the material.
 - A. Bars with bends not shown on the drawings shall not be used.
 - B. Bars that are partially embedded in concrete shall not be bent.
- D. Reinforcing Steel Positioning:
- 1. Reinforcing steel shall be positioned in accord with the drawings and secured by using annealed wire ties or clips at inter-sections and support by concrete or metal supports, spacers, or metal hangers. Metal clips or supports shall not come in contact with the forms. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage. Bars in addition to those shown on the drawings, which may be found necessary or desirable for the purpose of securing reinforcement in position, may be provided, at no additional expense to the department.
- E. Clearance and cover:
- 1. Reinforcing steel shall be placed a minimum of 2 inches clear of any metal pipe or fittings. Unless otherwise indicated on the drawings, reinforcement shall be placed so as to provide the thickness of protective concrete covering in accordance with ACI 318.
- F. Tolerances:
- 1. Unless otherwise shown or specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318.
 - 2. Accessories used to support reinforcing bars shall be placed and spaced such that deflections of supports due to weight of supported bars is within tolerances specified by ACI 117 and ACI 318.

3.03 SPACING OF REINFORCEMENT

- A. Spacing must be as indicated in the Contract Documents.
- B. Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to preapproval by the Contracting Officer.

3.04 SPLICES

- A. Unless otherwise shown, splices in adjacent horizontal bars shall be staggered 48 bar diameters.
 - 1. Bars shall be spliced only at points shown on the approved bending lists and placing drawings or where approved by the engineer.
 - 2. Use lap splices conforming to ACI 318 or as shown. In case of differences, use longer splices length. Bars in lapped splices shall be in contact and shall be tied to maintain the bar spacing shown on the drawings.
 - 3. Use of mechanical couplers is not permitted.
 - 4. Do not weld or tack-weld reinforcing bars.

3.05 REINFORCEMENT INSPECTION

- A. Periodic special inspection is required by Chapter 17 of CBC (Table 1704.3 and 1704.4) shall be completed by the engineer for the following for steel reinforcement:
 - 1. Size, grade, and type.
 - 2. Placement.

3.06 CONCRETE PROPORTIONING AND MIXING

- A. General
 - 1. Batch, mix, and deliver to placement site in accordance with ASTM C94.
- B. Amount of Water and Slump Test
 - 1. The amount of water required for the proper consistency of concrete shall be determined by means of the slump test, made in accordance with ASTM Method C143.
 - 2. The amount of water given in the above table is a maximum. The maximum allowable slump shall be as follows:

a. Thin sections and columns	Not more than 5"
b. Heavy sections, footings & slabs	Not more than 3"
c. Concrete placed under water	Not more than 8", Not less than 6"
 - 3. The amount of water may be varied in accordance with the dampness of the materials and the requirements of the workability of the aggregate within the limits of the slump tests given above.

C. Measuring Water

1. The equipment for measuring and supplying the water to the mixer shall be so constructed and arranged that the amount of water to be added to the mixture can be measured positively and that the predetermined quantity of water required can be discharged rapidly in one operation into the mixing drum. The equipment shall be designed so that water from the source of supply cannot enter the measuring tank while the water is being discharged from the measuring tank into the mixer. Tanks or other equipment for measuring and discharging water into the mixer shall be sufficiently accurate that the amount of water delivered to the mixer for any batch shall not vary more than one percent from the required quantity of water for any position of the mixer. The tanks or other equipment shall be arranged to permit checking the amount of water delivered by discharging into measured containers.

D. Job Mixing

1. The capacity of the mixer shall be adequate to handle one or more full sack batches. No split sack batches will be permitted, unless all materials are weighed. At no time shall the mixer be loaded beyond its capacity. The capacity of the mixer shall be considered to be the rated capacity as given in the manufacturer's catalog, provided that a quantity equal to the rated capacity can be thoroughly mixed in the prescribed time period and that there is no loss of ingredients during the mixing. Each batch shall be mixed not less than 1.50 minutes after all ingredients are in the mixer and until the mixture is uniform and homogeneous. It shall be completely discharged. The peripheral speed of concrete mixing drums shall be approximately 200 feet per minute. The mixer shall be equipped with an automatic time lock on the discharge control arranged to start the time cycle on the stroke of the material skip or on the closing of the hopper gate.

E. Transit Mixing

1. Transit-mixed concrete shall be in accordance with ASTM C94 and be of not less than 10 minutes at a peripheral drum speed of approximately 200 feet per minute. Mixing shall be continued until discharge is complete. At least three minutes of the mixing period shall be at the job site. The transit mixer shall be equipped with water measuring devices consisting of either accurately calibrated water tanks or water meters. Transit-mixed concrete will be rejected if not placed within 1.50 hours after water is first added to the batch.
2. Should the Contractor elect to utilize transit mixing equipment he shall make advance arrangements to prevent delays in delivery and placing of the concrete. An interval of more than 45 minutes between any two consecutive batches or loads, or a delivery and placing rate of less than 8 cubic yards of concrete per hour, shall constitute cause for shutting down the work for the remainder of the day, and if so ordered by the Engineer, the Contractor shall make, at his own expense, a construction joint at the location and of the type directed by the Engineer in the concrete already placed.

F. Forms

1. Forms shall conform to the shape, lines and dimensions called for on the Plans and shall be substantial and mortar tight. All vertical surfaces shall be formed, except where specifically authorized to the contrary. Temporary openings at the bottom of the wall forms and temporary openings at the base of all columns and piers shall be provided as required for cleaning and to facilitate inspection.

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2. Drip beads, feature grooves and other concrete details shall be carefully formed with surfaced material which shall be thoroughly coated with oil or other approved products before concrete is poured. Method of forming shall be selected for ease of stripping without damage to details. All exterior corners shall be chamfered 3/4 inch unless otherwise specifically shown.
3. Bolts or form clamps shall be of sufficient strength and number to prevent spreading of forms. They shall be of a type which can be entirely removed or cut back one inch below the finished surface of the concrete. All forms for outside surfaces shall be constructed with stiff wales at right angles to the studs and all form clamps shall extend through and fasten to such wales. Forms shall be so constructed that side forms where surface finishing is required can be removed without disturbing supporting forms.
4. Where woodwork comes into contact with concrete, proper anchors shall be provided. End studs of frame walls shall be bolted and dovetailed nailing blocks shall be provided for trim and other woodwork. Anchors in jambs of openings shall be spaced not more than two feet on centers.
5. Anchor bolts shall be positively positioned and anchored in the forms with templates and checked by the Engineer before concrete is poured.
6. If there is any question regarding the strength of forms, the recommendations of the manufacturer of the form ties shall be followed.
7. Non-supporting forms may be removed in 48 hours and supporting forms in not less than 21 days unless approval for earlier removal is granted by the Engineer. Forms shall be carefully removed so as not to endanger the structure or damage the surface.

3.07 CONCRETE CONVEYING AND DEPOSITING

- A. Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent segregation or loss of material. Concrete shall not be deposited in a manner which shows segregation to occur, and shall be deposited as nearly as practicable in its final position to avoid segregation during rehandling.
- B. No concrete which has partially hardened or been contaminated by foreign material shall be deposited on the work, nor shall retempered concrete be used. When concreting is started it shall be carried on as a continuous operation until the section is completed, maintaining the top surface level.
- C. All concrete shall be compacted with mechanical vibrators in a manner satisfactory to the Engineer. At least two satisfactory vibrators shall be on the job during every pour and more if required by the Engineer. If it is deemed necessary by the Engineer, surfaces that are to be exposed shall be spaded and hammered to obtain a good surface. Concrete shall not be permitted to fall from a height greater than 6 feet without the use of adjustable length pipes or "elephant trunks." The use of chutes in conveying and depositing concrete will be allowed only at the discretion of the Engineer, and wherever they are used, they shall be laid at an inclination that will permit the flow of concrete of the required consistency. Where necessary to prevent separation, chutes shall be provided with baffle boards or a reversed section at the outlets. Columns shall be poured through pipes of adjustable length and not less than 6 inches in diameter. The use of additional water in mixing the concrete to promote free flow in chutes of low inclination will not be allowed.

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- D. For columns and walls, concrete shall be allowed to set at least 4 hours before caps, girders, floor slabs, or other connecting members are poured so that the column may obtain its shrinkage before the superstructure is placed.
- E. Where it is necessary to deposit concrete under water, concrete shall be placed by use of a tremie tube. Care shall be exercised to see that the lower end of the tremie tube does not rise above the surface of the concrete during the pour, to avoid contamination with water. Depositing of concrete under water shall be permitted only with the approval of the Engineer, where it is not possible to de-water.

3.08 PUMPING CONCRETE

- A. Equipment Capacity Requirements
 - 1. Pump size shall be determined by the rate of concrete placement, length of delivery pipe or hose, aggregate size, mix proportions, vertical lift, and slump of concrete.
 - 2. Minimum inside diameter of pipe or hose shall be based on the maximum aggregate size as follows:
 - a. 1-inch max aggregate: Three-inch min ID.
 - b. Larger aggregate sizes: as directed by the ENGINEER.
- B. Disallowance of Aluminum Pipe
 - 1. Aluminum pipes shall not be used for delivery of concrete to the forms.
- C. Priming
 - 1. Before pumping is started, the delivery pipe or hose shall be primed by pumping mortar through the line using five gallons of mortar for each 50 feet of delivery line. Mortar shall be pumped to waste and not deposited in the forms.

3.09 COLD WEATHER WORK

- A. Concrete shall not be mixed nor placed while the atmospheric temperature is at or below 35 degrees Fahrenheit unless means are employed to heat the aggregate and water, and satisfactory provisions have been made for protecting the work. All concrete shall be effectively protected from frost action for a period of five days after placing and will not be accepted before the expiration of a thirty day period during which the temperature of the concrete does not fall below 40 degrees Fahrenheit.
- B. The concrete shall be maintained at a temperature of at least 50 degrees Fahrenheit for not less than 72 hours after placing or until it has thoroughly hardened.
- C. The temperature of the concrete as it leaves the mixer shall not be less than 50 degrees Fahrenheit, nor more than 120 degrees Fahrenheit unless otherwise specified. Upon written notice from the Engineer, all concrete which may have become damaged by frost action shall be replaced by the Contractor at his own expense.

3.10 BONDING TO EXISTING CONCRETE

- A. Existing concrete to which new concrete is to be bonded shall have the contact surfaces coated with materials listed in Part 2 of this section. The method of preparation and application of the bonding compound shall conform to the manufacturer's printed instructions and recommendations for specific application for this project.

3.11 CONSTRUCTION JOINTS AND EXPANSION JOINTS

- A. Construction joints in structural concrete shall be level or vertical and shall be of the type and location as the Engineer directs or as shown on the Plans. Joints not indicated on the Plans shall be so made and located as to least impair the strength of the structure and shall conform to the typical details.
- B. The horizontal surface of all construction joints shall be cleaned and roughened by removing the entire surface and exposing clean aggregate solidly embedded in mortar matrix in accordance with the following procedure. The contact surface must be thoroughly cleaned by chipping or sand blasting the entire surface not earlier than 5 days after initial pour or by an approved method that will assure equal bond such as a thorough hose washing of the surface not less than 2 nor more than 4 hours after the concrete is placed (depending on setting time). All wash and chalklike material shall be entirely cleaned from the surface.
- C. In the event that the contact surface becomes coated with earth, sawdust, etc., after being cleaned, the entire surface so coated shall be recleaned.
- D. All construction joints shall be slushed with neat cement grout immediately ahead of the pour.
- E. Water stops shall be installed in construction joints where shown on the Plans. Where no construction joint is shown on the Plans, but is permitted by the Engineer, water stops shall be installed as directed by the Engineer.
- F. Unreinforced slabs, walks, curbs, etc., shall have construction joints at not to exceed 12-foot centers and expansion joints at not to exceed 48-foot centers. Reinforced slabs, walks, curbs, etc., shall have construction joints at not to exceed 20-foot centers and expansion joints at 40-foot centers. Expansion joint material shall be placed along all walls and around each column and projection.

3.12 CONCRETE FINISHING

- A. Structures
 - 1. Forms shall be removed as soon as permissible and, immediately thereafter, tie rod holes, rock pockets, and other defects shall be chipped to expose sound aggregate and mortar and then shall be dashed with neat cement paste and dry packed with moistened 1 to 2 cement sand mortar thoroughly tamped in.
 - 2. After patches have thoroughly hardened, surfaces that are to be exposed or painted in the finished structures shall be rubbed mechanically or by hand with carborundum stones to eliminate traces of forms and patch work. A brush coat of thin cement mortar consisting of one part cement and one part sand that will pass a No. 16 screen or at the option of the Engineer a neat cement wash shall be applied if necessary to give a uniform appearance. In either case, five percent calcium chloride shall be used. When the cement film has set sufficiently so that the sand particles and cement will not draw out of

surface pin holes, but before final set has taken place, the entire surface shall be rubbed with fine carborundum stones (No. 25 to No. 30) until a smooth, even surface of even texture, color and appearance is obtained. No greater amount of mortar shall be applied in advance of rubbing than can be completely rubbed before final setting takes place. Immediately following the rubbing process, the finished surface shall be thoroughly washed with water.

3. Finish fiber reinforced concrete in accordance with the fiber manufacturer so as to minimize visible fibers at the surface of the concrete.

3.13 SLABS, WALKS, STEPS, CURBS, AND GUTTERS

- A. Placement, cure, and finish requirements shall be in accordance with Technical Specification titled “**Concrete Curbs, Gutters, and Sidewalks.**”

3.14 CURING

- A. All concrete shall be protected from injury and shall be kept continuously wet for a period of ten (10) days after pouring. The use of curing compounds will not be permitted without the approval of the Engineer.
- B. Curing requirements for curbs, gutters, slabs, and sidewalks shall be in accordance with Technical Specification titled “**Concrete Curbs, Gutters, and Sidewalks.**”



PART 1 GENERAL

1.01 SCOPE

- A. This heading covers the removal, furnishing, placement and compaction requirements for concrete curbs, gutters, sidewalks, and slabs, complete.

1.02 SUBMITTALS

- A. Submittals shall be furnished as specified herein and in accordance with technical specification "Submittals".
- B. Submit manufacturer's literature, catalog data, and statement of compliance with referenced standards and specifications.
- C. Submit Owner inspection requests a minimum seventy-two (72) hours in advanced prior to the following:
 - 1. Finished subgrades for curbs, gutters, sidewalks, and slabs.

PART 2 MATERIALS

2.01 FORMS

- A. General: Forms shall be as required in Technical Specification titled "**Concrete Work.**" Stakes and braces shall be provided to hold forms securely in place.
- B. Sidewalk Forms: Sidewalk forms shall be 2-inch dressed lumber, straight and free from defects, or standard metal forms. Where short-radius forms are required, 1-inch dressed lumber or plywood may be used.

2.02 AGGREGATE BASE COURSE

- A. Aggregate base material shall conform to the requirements listed in Technical Specification titled "Aggregate Base."

2.03 EXPANSION JOINT FILLER

- A. Unless otherwise shown or specified, premolded expansion joint filler shall be 1/2-inch thick for curbs and 1/2-inch thick for sidewalks.
- B. Expansion joint filler shall conform to the requirements listed in Technical Specification titled "**Concrete Work.**"

2.04 CONCRETE

- A. Concrete shall conform to the requirements listed in Technical Specification titled "**Concrete Work.**"

2.05 REINFORCING STEEL

- A. Reinforcing steel shall conform to the requirements Technical Specification titled "**Concrete Work.**"

2.06 CURING COMPOUND

- A. Curing compound shall conform to the requirements Technical Specification titled “**Concrete Work.**”
- B. Curing compound shall conform to ASTM C 309, Type 2, Class B, and shall be compatible with the local air quality management district’s requirements.

PART 3 EXECUTION

3.01 GENERAL

- A. Excavation, backfill, and compaction shall conform to Technical Specification titled “**Excavation, Backfill, and Compaction.**”

3.02 PAVEMENT REMOVAL

- A. Public Safety
 - 1. The Contractor shall comply with all applicable, State of California and the City of Orland requirements for temporary closures of streets, parking lots, or other areas. The Contractor shall provide barriers, guards, light, signs, temporary bridges, flag persons and watch persons, advising the public of detours and construction hazards. The Contractor shall furnish and install, and upon completion of the work, promptly remove all signs and warning devices. The Contractor shall comply with all the public safety and signing requirements specified in the SSPWC, Section 7 and the California Manual on Uniform Traffic Control Devices, latest edition. Should two or more specifications be in conflict, the more restrictive of the two shall be followed.
- B. Project Cleanliness
 - 1. The Contractor shall ensure that all areas of the site are kept clean of debris and construction materials outside of the region designated for storage and staging. Upon the conclusion of the project, the Contractor shall ensure that all curbs, sidewalks, cross gutters, decorative slab on grade, signs, landscaping drive approaches, etc., are returned to their preconstruction condition and/or new construction status having no marks or material coatings unless designated otherwise. The Contractor shall clean these areas if requested to do so by the Owner prior to the final completion of the project.
- C. Portland Cement Concrete Pavement Cutting Requirements
 - 1. Concrete pavement, cross gutters, curbs and gutters, sidewalks, or driveways, shall be saw cut the full depth in accordance with Technical Specification titled “Clearing, Grubbing, and Demolition” and to the satisfaction of the Owner. Concrete pavement may initially be cut at the limits of the excavation by other methods prior to removal and the saw cut made after backfilling the excavation. If the saw cut falls within 3-feet of a concrete joint or pavement edge, the concrete shall be removed and replaced to the joint or edge.
 - 2. Saw-cutting, removal, and disposal of existing concrete pavement shall be in accordance with Section 39-3 of the State Standard Specifications.
- D. Disposal of Material

1. All pavement and other improvements demolished shall be removed from the site and disposed of in a legal manner per Technical Specification titled “**Clearing, Grubbing, and Demolition**” and to the satisfaction of the Owner.

E. Final Pavement Saw Cuts

1. Excavation shall be regular and rectangular in shape and shall be blade-cut or saw-cut, as appropriate to the field conditions through the existing pavements. Cuts shall be made in straight lines. Excavation shall be taken to the limits identified on the site drawings. Excavation material shall be hauled from the job site. Removal shall be considered as Unclassified Excavation.

3.03 PREPARATION OF SUBGRADE

- A. Subgrade shall be excavated and shaped to line, grade, and cross section as necessary to construct concrete curbs, gutters and/or sidewalks per applicable City of Orland’s Standard Details (Details 202 through 209). The top 12-inches of subgrade shall be removed and compacted to 92 percent relative density in accordance with ASTM D 1557 in lifts not to exceed 6 inches. All soft material disclosed by excavating shall be removed and replaced with aggregate base as directed by the Engineer.
- B. The finished subgrade shall be within a tolerance of +/-0.02 of a foot of the grade and cross section shown and shall be smooth and free from irregularities at the specified relative density in accordance with ASTM D 1557.
- C. The subgrade shall extend over the full width of the concrete curbs, gutters, and/or sidewalks being constructed.
- D. The Owner's approval of finished subgrades must be received prior to continuance of the work.

3.04 PLACING AGGREGATE BASE

- A. After the subgrade for curbs, sidewalks, and roadway slabs is compacted and accepted, the Contractor shall place and spread aggregate base material, sprinkle with water, and compact to 95 percent relative density. The surface of the compacted base shall be at the proper level to receive concrete. Curbs and sidewalks shall be underlain by 2-inches of compacted aggregate base material. Where sidewalk abuts a rolled curb and gutter, the thickness of the aggregate base under the sidewalk shall be the same as the thickness placed under the street pavement.

3.05 SETTING FORMS

- A. Forms shall conform to Technical Specification titled “**Concrete Work.**” Forms for a face-of-curb shall not have any horizontal joints within 7-inches of the top of the curb. Forms shall be braced to prevent change of shape or movement in any direction resulting from the weight of the concrete. Short-radius curved forms shall be constructed to exact radius. Tops of forms shall not depart from grade line more than 1/8-inch when checked with a 10-foot-straight edge. Alignment of straight sections shall not vary more than 1/8-inch in 10-feet.

3.06 CURB CONSTRUCTION

A. Jurisdictional Requirements

1. Curbs shall be reconstructed to original line and grade if removed. Curbs shall conform to City of Orland requirements.

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- B. Expansion Joints
 - 1. Preformed asphalt-impregnated expansion joints shall be placed in accordance with applicable City standards.
- C. Contraction Joints
 - 1. Contraction joints shall be provided in accordance with applicable City standards.
- D. Notification
 - 1. The Owner shall be notified at least 72-hours in advance of planned concrete placement.
- E. Concrete Placement and Finish
 - 1. Curbs and gutters shall be screeded to true cross section and grade. The screed shall be operated parallel to the line of the curb. The surface shall then be worked with a wood float as setting progresses, troweled smooth and given a fine brush finish parallel to the line of the curb. Corners shall be rounded. The forms on the face of the curb shall be removed not more than six (6) hours after concrete has been placed. The face shall be brushed with grout, troweled smooth and brushed to match the rest of the curb. The face of the finished curb shall be true and straight and the top surface of the curb and gutter shall be of uniform height and free from irregularities. The surface shall not vary more than 1/8 inch from the edge of a 10-foot straight edge except at grade changes and curves.
- F. Curing
 - 1. Upon completion of the finishing, curing compound shall be applied to exposed surfaces of the curb. Curing shall continue for a minimum of five days.
- G. Backfill
 - 1. Seven days (minimum) after placing the concrete, the curb shall be backfilled with earth free from rocks, 2-inches and larger, and other foreign material. Backfill shall be tamped firmly in place to 95 percent relative density in accordance with ASTM D 1557.
- H. Alignment and Grade
 - 1. Finished curb shall have a uniform grade and alignment. Any section of curb showing abrupt changes in alignment or grade, or is more than 1/4-inch away from its intended location as staked, shall be removed and reconstructed at no additional cost to the Owner.
- I. Protection of Work
 - 1. All concrete surfaces and/or structures shall be protected until the project containing the work is accepted.

3.07 SIDEWALK CONSTRUCTION

- A. General Requirements

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Unless otherwise shown or specified, sidewalks shall be placed in a single layer, 4 inches thick. Walks shall slope 1/4-inch per foot upward from the top of curb. Concrete shall be placed, processed, finished, and cured in conformance with the applicable requirements of ACI 304R, latest edition.

B. New Sidewalk

1. Unless otherwise shown or specified, where new sidewalk is to abut existing concrete, the existing concrete shall be sawcut to a depth of 2-inches and the concrete chipped out to sound material and a vertical plane surface. The surface shall be cleaned, and a neat cement paste applied just prior to placing the new concrete sidewalk.

C. Expansion Joints

1. Preformed asphalt-impregnated expansion joints shall be placed in accordance with applicable City standards.

D. Contraction Joints

1. Contraction joints shall be provided in accordance with applicable City standards.

E. Notification

1. The Owner shall be notified at least 72-hours in advance of planned concrete placement.

F. Concrete Placement and Finish

1. After concrete for slabs or sidewalks has been placed between the side forms, a strikeoff guided by the side forms shall be used to bring the surface to the proper section to be compacted. After screeding off, the surface shall be tamped with a heavy tamper consisting of a grid of metal bars until a layer of mortar not less than 3/8-inch thick has been brought to the surface.
2. The surface shall be rescreeded to a true surface, worked with a wood float as settling progresses and troweled with a steel trowel a sufficient number of times to produce a smooth, hard finish. After troweling, the surface shall be broomed if required. Care shall be taken to obtain a true surface on slabs, especially at walls and joints. Slab surfaces shall not vary more than 1/4-inch at any point from an 8 foot straight edge. The use of topping or dusting with dry cement and sand shall not be permitted unless it is desired to apply an integral color. No more slabs shall be poured in one day than can be finished to a satisfactory surface.
3. If colored slabs are called for in the Plans, the finish shall be as specified except that the coloring shall be applied in the finished process in strict accordance with the Manufacturer's directions.
4. Treads of steps and stairs shall be worked with a wood float to an even surface, troweled to a smooth surface with a steel trowel and given a light brush finish. Use of topping or dry cement and sand will not be permitted. Edges and corners shall be rounded and the tread shall be scored with not less than four grooves the length of all treads near the edge. Forms on risers and other exposed vertical surfaces shall be removed not more than six (6) hours after concrete has been placed. Risers and vertical surfaces shall be brushed with grout and troweled smooth or finished as directed by the Owner.

G. Curing

1. Concrete slabs and walks shall be covered with "Sisal-Kraft" paper, sand, or sawdust as soon as they are hard enough to walk on and shall be kept continuously wet for ten (10) days after pouring. Care shall be taken to prevent exposed slabs from becoming stained.
2. Alternatively, upon completion of the finishing, curing compound shall be applied to exposed surfaces of the sidewalk. Curing shall continue for a minimum of five days.

3.08 INSPECTION AND TESTING

- A. Inspection and testing shall be in accordance with Technical Specification titled "Trench Excavation and Backfill" and Technical Specification titled "**Concrete Work.**"

3.09 REMOVAL OF REJECTED AND UNAUTHORIZED WORK

- A. Work which has been rejected shall be remedied or removed and replaced in an acceptable manner as determined by the Owner. Any work done beyond the lines and grades shown on the Plans or established by the Owner or determined by the Owner to not be of acceptable material quality, or of acceptable workmanship, or any work done without written authority shall be considered as rejected work. Upon order of the Owner, work shall be remedied, removed, or replaced to the satisfaction of the Owner at no expense to the Owner.

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section lists the requirements for materials and installation of structural steel, connecting bolts, stainless-steel anchors, ladders, access hatches, and gratings, and miscellaneous hardware.
- B. Provide materials, equipment and labor required to execute this work as indicated on the drawings, specified herein and necessary to complete the work of this section.

1.02 REFERENCES

- A. The following publications form a part of this specification to the extent referenced.
 - 1. American Concrete Institute (ACI):
 - a. ACI 318 Building Code Requirements for Structural Concrete.
 - 2. American Institute of Steel Construction (AISC):
 - a. AISC 341 Seismic Provisions for Structural Steel Buildings.
 - b. AISC 360 Specification for Structural Steel Buildings
 - c. AISC Steel Construction Manual
 - 3. American Society for Testing and Materials (ASTM):
 - a. ASTM A 36 Standard Specification for Carbon Structural Steel.
 - b. ASTM A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. ASTM A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - d. ASTM A 153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - e. ASTM A 167 Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - f. ASTM A 194 Standard Specification for Carbon Steel, Alloy Steel, and Stainless-Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - g. ASTM A 240 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

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- h. ASTM A 276 Standard Specification for Stainless Steel Bars and Shapes.
 - i. ASTM A 307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.
 - j. ASTM A 493 Standard Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.
 - k. ASTM A 500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - l. ASTM A 501 Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 - m. ASTM A 563 Standard Specification for Carbon and Alloy Steel Nuts.
 - n. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - o. ASTM A 780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - p. ASTM C 881 Standard Terminology Relating to Aluminum- and Magnesium-Alloy Products.
 - q. ASTM E 165 Standard Practice for Liquid Penetrant Examination for General Industry
 - r. ASTM E 709 Standard Guide for Magnetic Particle Testing
 - s. ASTM F 436 Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
 - t. ASTM F 593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - u. ASTM F 594 Standard Specification for Stainless Steel Nuts.
 - v. ASTM F 844 Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
 - w. ASTM F 2329 Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
4. American Welding Society (AWS):
- a. AWS D1.1 Structural Welding Code-Steel

- b. AWS D1.3 Structural Welding Code – Sheet Steel
- 5. California Building Code (CBC), 2022.
- 6. ICC Evaluation Service (ICC-ES):
 - a. AC 193 Mechanical Anchors in Concrete Elements.
 - b. AC 308 Acceptance Criteria for Post-installed Adhesive Anchors in Concrete Elements.
- 7. Standard Specifications for Public Works Construction (SSPWC):
 - a. Standard Specifications for Public Works Construction.
 - b. Standard Plans for Public Works Construction.

1.03 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled “**Submittals.**”
- B. Submit drawings of fabricated items, such as pipe supports, bolts, ladders, concrete anchors, grating, and access hatches. Show dimensions and reference materials of construction by ASTM designation and grade.
- C. Product Data:
 - 1. Certified mill test results on structural metals.
 - 2. Electrode manufacturer’s data and product data, including electrodes to be used for dissimilar metals.
 - 3. Manufacturer’s product data sheets or catalog data for SMAW, FCAW and GMAW composite (cored) filler metals to be used.
 - 4. Insulation between dissimilar metals.
 - 5. Adhesive anchors, reinforcing steel dowels and expansion anchors.
 - 6. ICC-ES Evaluation Reports for all anchors submitted demonstrating compliance with 2012 IBC and ICC AC 193 or 308 for Mechanical or Adhesive anchors respectively. Report shall demonstrate approval for use in cracked concrete in Seismic Design Categories A-F.
 - 7. List of all anchors to be used including location, diameter, number, and length of anchors.
 - 8. Shop and Erection Drawings
 - a. Structural framing.
 - b. Show dimensions, finishes, joining, attachments, inserts, and relationship of work to adjoining construction.
 - c. Indicate all shop and erection details including cuts, copes, connections, holes, threaded fasteners and welds. Indicate welds using AWS “Welding Symbols.”

- 9. Welding
 - a. Welder performance qualification test records “welders certification.”
 - b. Written Welding Procedure Specifications (WPSs) in accordance with AWS D1.1 requirements for each different welded joint proposed for use whether prequalified or qualified by testing.
 - c. Procedure Qualification Record (PQR) in accordance with AWS 1.1 for all procedures qualified by testing.

1.04 QUALITY ASSURANCE

A. Visual welding inspection and nondestructive testing (NDT) shall be conducted in accordance with a written practice by personnel qualified in accordance with AISC 341 Appendix W.

- 1. Visual Inspection
 - a. Check fit-up of joint materials. Verify satisfactory alignment of material. Verify gaps and bevels of penetration welds.
 - b. Check during welding. Verify satisfactory technique is used.
 - c. Check after welding completed and cleaned by wire brush or chipping hammer.
 - d. Inspect with magnification when necessary and under strong, adequate light.
 - e. Inspect for the following defects.
 - 1) Surface cracking
 - 2) Porosity
 - 3) Excessive roughness
 - 4) Unfilled craters
 - 5) Gas pockets
 - 6) Undercuts
 - 7) Overlaps
 - 8) Size
 - 9) Insufficient throat and concavity
- 2. Nondestructive testing
 - a. Ultrasonic testing, except where not feasible due to the type or location of the weld. Magnetic particle, liquid penetrant, or radiograph tests when ultrasonic testing is not feasible.
 - 1) Ultrasonic inspection technique and standards: AWS D1.1 Part C.
 - 2) Magnetic Particle inspection method: ASTM E 709.

- 3) Liquid Penetrant inspection method: ASTM E 165.
 - 4) Radiography tests: AWS D1.1, Part B.
 - 3. Extent of testing
 - a. Visual inspection of all welds.
 - b. Measurement of weld profiles for 25 percent of all welds at random.
 - c. Ultrasonic contact examination on all complete joint penetration (CJP) welds. Defective welds shall be repaired, and costs of retesting defective welds shall be paid for by the Contractor.
 - 4. Additional Tests
 - a. Contractor shall provide and pay for all necessary additional tests made on welds or bolts required to repair or replace faulty work performed during the original fabrication.
- B. Concrete Anchor Quality Assurance:
- 1. In accordance with ACI 318, concrete anchors shall be installed by qualified personnel in accordance with the contract documents and installation of adhesive anchors shall be performed by personnel trained to install adhesive anchors.
 - 2. The Contractor shall provide Special Inspection, defined by CBC Chapter 17. The Contractor shall provide and pay for Special inspection for mechanical and adhesive anchoring systems as required by ICC-ES. Installation inspection shall be periodic special inspection.
 - 3. Visual inspection of layout including horizontal location, minimum embedment, minimum cover, minimum spacing, and minimum edge distance.
 - 4. Additional Tests:
 - a. Contractor shall provide and pay for all necessary additional tests made on welds or bolts required to repair or replace faulty work performed during the original fabrication.

PART 2 MATERIALS

2.01 STRUCTURAL STEEL

- A. Material for all-purpose bolted or welded construction shall conform to ASTM A 36 or equal.
- B. Wide Flanges and Tees:
 - 1. ASTM A992
- C. Hollow Structural Shapes (HSS), Structural Steel Tubing:
 - 1. ASTM A 500, (cold formed) Grade B, or ASTM A 501 (hot formed), welded or seamless.

- D. Steel Pipe:
 - 1. Seamless, conforming to ASTM A 53, Type E or S, Grade B.

- E. Gauge Metal / Sheet Metal:

- 1. ASTM A 653.

2.02 NUTS, BOLTS AND WASHERS

- A. For buried, submerged, or conditions where anchors or fasteners will be continuously or intermittently wet, except where otherwise shown or specified, all bolts, anchor bolts, mechanical anchors, adhesive anchors, washers, and nuts shall be 316 stainless steels.
- B. For exterior or exposed conditions, provide 316 stainless steels except where otherwise shown or specified.
- C. For all other exposure conditions provide hot dipped galvanized materials, except where otherwise shown or specified.

- D. Bolting-Steel:

- 1. Bolts: ASTM A 307, Grade A (Regular Hexagon Bolts).
 - 2. Nuts: ASTM A 563, Grade A (Regular Hexagon Nuts).
 - 3. Washers: ASTM F 844 (Regular Bolt Circular Washers).

- E. Bolting-Stainless Steel:

- 1. Bolts: AISI 316.
 - 2. Nuts: ASTM A 194 or F 594.
 - 3. Washers: AISI 316 washers meeting the dimensional requirements of ASTM F 436.

2.03 GALVANIZING

- A. Hot-dip galvanize all exterior ferrous metal work and all noted interior ferrous metal work.
- B. Hot-dip galvanize all sheet steel, plain or shaped in accordance with ASTM A 653, G-90 Commercial Grade.
- C. Hot-dip galvanize all products fabricated from rolled, pressed, and forged steel shapes, plates, bars and strip 1/8-inch thick or heavier, in accordance with ASTM A 123.
- D. Hot dip galvanizes all steel hardware, nuts, bolts, washers, anchors, and threaded rods in accordance with ASTM A 153 or F 2329. Size thread clearance to allow for galvanized coating; rerun threads after galvanizing, if required, to assure a smooth fit.
- E. Repair all damaged galvanizing by heated repair method. Repair materials shall be ReGalv by Roto metals, Inc., San Francisco, CA; or equal.

2.04 STEEL WELDING ELECTRODES

- A. AWS A5.1 or A5.5, E70XX category.
 - 1. AWS A5.20, A5.29, E7XTX-x except -2, -3, -10, -GS for FCAW.
 - 2. AWS A5.17 or A5.23, F7XX-EXXX for SAW.
 - 3. For welding dissimilar metals, submit the appropriate electrodes for Product Review.

2.05 STAINLESS STEEL

- A. Except where otherwise specified, stainless steel plate, members, and washers shall be Type 316, ASTM A 167.

2.06 CONCRETE ANCHORS

- A. Mechanical Expansion Anchoring Systems
 - 1. Anchor:
 - a. Expansion anchor shall be preassembled expanding sleeve or wedge type with a single piece three section wedge. Anchors shall meet the description of Federal Specification A-A 1923A or A-A 1922A, Type 4. Anchor will bear a length identification code that is visible after installation. Provide hex head stud style unless flat or rod coupler styles are noted on drawings.
 - b. Stainless Steel Anchors:
 - 1) Anchor Body and Wedge: ASTM A 276 or ASTM A 493 with chemical composition of either AISI 304 or 316 or 316L.
 - 2) Nuts: ASTM F 594 with chemical composition of either AISI 304; or 316; or 316L.
 - 3) Washers: ASTM A 240 with chemical composition of either AISI 304; or 316; or 316L.
 - c. Submit a product evaluation report by ICC-ES showing Cracked Concrete testing compliance per A.C. 193.
 - d. Provide embedment depth, edge distance, and anchor spacing as shown on the Drawings and in accordance with manufacturer's recommendations for published allowable loads.
 - e. Manufacturer: Hilti, Inc., Kwik Bolt TZ; or equal.
- B. Adhesive (Epoxy) Injection Anchoring Systems.
 - 1. Adhesive
 - a. Adhesive consisting of two-component epoxy base resin and hardener material meeting the requirements of ASTM C 881 Types I and IV, Grade 3, Class C. The

adhesive shall be supplied in manufacturer's standard side-by-side cartridge and dispensed through a static-mixing nozzle supplied by the manufacturer.

2. Anchor Rod, Reinforcing Steel or Insert
 - a. Threaded Rod or insert with chamfered threaded end for ease of starting nut on one end and 45-degree chisel or cut point on opposite end (where insert is required by manufacturer). Furnish nuts and washers to meet the requirements of the rod or insert. Unless noted otherwise on the drawings provide hot dip galvanize rods or inserts or stainless steel. Stainless steel rods or inserts shall be provided in buried or submerged locations.
3. Anchors shall be embedded in existing concrete shall be embedded using the epoxy injection systems.
 - a. ASTM A 307 (standard carbon steel anchor, hot dip galvanized).
 - b. AISI 304/ASTM A 276 or AISI 316L/ASTM A 276 stainless steel meeting the mechanical requirements of ASTM F 593 (Condition CW).
4. Submit a product evaluation report by ICC-ES showing Cracked Concrete testing compliance per A.C. 308.
5. Provide embedment depth, edge distance, and anchor spacing as shown on the drawings and in accordance with manufacturer's recommendations for published allowable loads.
6. Manufacturer:
 - a. Hilti HIT RE 500-SD, Epoxy Anchoring System; Hilti HIT HY-150 MAX-SO, Simpson Strong-Tie SET-XP Epoxy; or equal.
 - b. For materials with voids and holes like hollow block provide Simpson Strong-Tie ETS screens used with SET Epoxy; or equal.

2.07 METALLIC GRATING

- A. Unless noted otherwise, metallic grating shall be galvanized steel. Main bars shall be of the size and thickness indicated on the drawings.

2.08 TANK WATER LEVEL INDICATOR

- A. Tank water level indicator materials shall be as shown on the Drawings.

PART 3 EXECUTION

3.01 STORAGE OF MATERIALS

- A. All material, either plain or fabricated, shall be stored above ground on platforms, skids, or other supports. Material shall be kept free from dirt, grease, and other foreign matter and protected from corrosion.

3.02 CONSTRUCTION METHODS

- A. Construction methods shall comply with all applicable sections of the Standard Specifications for Public Works Construction (SSPWC), latest edition, unless noted otherwise herein.

3.03 EXAMINATION

- A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.04 FABRICATION AND ERECTION

- A. General:

- 1. Miscellaneous metal items shall be fabricated to straight lines and true curves. Drilling and punching shall not leave burrs or deformations. Permanent connections shall be welded continuously along the entire area of contact. Exposed work shall have a smooth finish with welds ground smooth. Joints shall have a close fit with corner joints coped or mitered and shall be in true alignment. Unless specifically indicated, there shall be no bends, twists, or open joints in any finished member nor any projecting edges or corners at intersections. Fastenings shall be concealed wherever possible. Built-up parts shall be free of warp. Exposed ends and edges of metal shall be slightly rounded. All bolt holes shall be 1/16 inch in diameter larger than bolt size. Cast-in-place bolt locations shall be measured in the field before drilling companion holes in structural steel beam or assembly.

- B. Surfaces in Contact with Concrete:

- 1. Surfaces of metalwork to be in contact with concrete shall be cleaned of rust, dirt, grease, and other foreign substances before placing concrete.

- C. Embedded Metalwork:

- 1. Embedded metalwork shall be set accurately in position when concrete is placed and supported rigidly to prevent displacement or undue vibration during or after the placement of concrete. Unless otherwise specified, where metalwork is to be installed in recesses in formed concrete, said recesses shall be made, metalwork installed, and recesses filled with dry-pack mortar in conformance with the Technical Specification section titled **“Concrete.”**

3.05 COMMON MACHINE BOLTS AND NUTS

- A. General:

- 1. Bolts shall be inserted accurately into the bolt holes without damaging the thread. Bolt heads shall be protected from damage during driving. Bolt heads and nuts 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, beveled washers shall be provided to give full bearing to the head or nut.

- B. Bolt Insertion:

1. Bolts shall be of the length that will extend entirely through but not more than 1/4 inch beyond the nuts. Bolt heads and nuts shall be drawn tight against the work.

3.06 ANCHOR BOLTS AND ANCHORS

A. General:

1. Anchor bolts to be embedded in concrete and concrete unit masonry shall be placed accurately and held in correct position with the use of templates while the concrete or grout is placed or, if specified, recesses or blockouts shall be formed in the concrete and the metalwork shall be grouted in place in accordance with Section 03300 - Concrete. The surfaces of metalwork in contact with concrete shall be thoroughly cleaned.
2. Concrete anchors shall not be used where cast-in-place anchor bolts are called for.
 - a. Anchor diameter and grade of steel shall be per contract documents or per equipment supplier specifications. Anchor shall be threaded or deformed full length of embedment and shall be free of rust, scale, grease, and oils.
 - b. Embedment depth shall be as specified on the Drawings.
 - c. All installation recommendations by the anchor system manufacturer shall be followed carefully, including maximum hole diameter.
 - d. Holes shall have rough surfaces, such as can be achieved using a rotary percussion drill.
 - e. Holes shall be blown clean with compressed air and be free of dust or standing water prior to installation.
 - f. Anchor shall be left undisturbed and unloaded for full adhesive curing period.
 - g. Concrete temperature (not air temperature) shall be compatible with curing requirements of adhesives per adhesive manufacturer. Anchors shall not be placed in concrete below 25°F.
3. Protection of Anchor Bolts:
 - a. After anchor bolts have been embedded, bolt threads shall be protected by applying anti-seize compound and by placing the nuts on the treaded bolt end until the time of installation of the equipment or metalwork.

3.07 CONTROL OF FLAME CUTTING

- A. The use of a gas-cutting torch in the field for correcting fabrication errors on any member in structural framing shall not be permitted. A flame-cutting torch shall be used only on minor members, when the member is not under stress.

3.08 REPAIR OF GALVANIZED SURFACES

- A. Damaged galvanized metal surfaces shall be repaired or replaced at no additional cost to the Owner. Heat repair damaged galvanized surfaces per ASTM A 780 with ReGalv by Rotometals; or equal, in accordance with the manufacturer's recommendations.

3.09 WELDING

- A. Weld only in accordance with favorably reviewed WPSs, which are to be available to welders and inspectors during the production process. Perform all welding by the shielded electric arc method in accordance with AWS D1.1.
- B. Repair and make additional inspections, at the Contractor's expense, of the weld areas which have been rejected as a result of inspection. Follow this procedure until the welds are acceptable to the Engineer.
- C. Qualify welders in accordance with AWS D1.1 for each process, position, and joint configuration.
 - 1. All tack welds shall be of the same quality as the final welds. This includes preheat requirements. All tack welds not incorporated in the final welds shall be removed.

3.10 GRATING

- A. Measurement:
 - 1. Grated areas shall be field measured for proper size.
- B. Banding:
 - 1. Grating shall be completely banded.
- C. Grating Angles:
 - 1. Seat angles for grating shall be set so that the top of the vertical leg is flush with the concrete floor. Seat angles and anchors shall be stainless steel.

3.11 CORROSION PROTECTION

- A. Aluminum surfaces that are in contact with concrete shall be coated in accordance with the Technical Specification section titled "**Protective Coating**". Coating shall be allowed to dry before placing in or against concrete.



PART 1 GENERAL

1.01 SCOPE

- A. This section describes the requirements for sealants, caulking, and accessories as shown and as specified.
- B. Provide materials, equipment and labor required to execute this work as indicated on the drawings, specified herein and necessary to complete the work of this section.
- C. Caulking and sealants shall be complete systems and shall be installed only by installers authorized and approved by the manufacturer.
- D. All items specified herein shall meet NSF 61 requirements where the product is used on potable water.

1.02 REFERENCES

- A. The following publications form a part of this specification to the extent referenced.
 - 1. Federal Specifications
 - a. TT-S-001543A Sealing Compound, Silicone Rubber Base, (For Caulking, Sealing and Glazing in Buildings and Other Structures).
 - b. TT-S-00230C(2) Sealing Compound, Elastomeric Type, (For Caulking, Sealing, and Glazing in Buildings and Other Structures).
 - 2. NSF International:
 - a. NSF 61 Drinking Water System Components.

1.03 SUBMITTALS

- A. Submit in accordance with Technical Specification section titled "Submittals".
- B. Manufacturer's Data:
 - 1. Contractor shall submit manufacturer's specifications, recommendations, and installation instructions for each type of sealant, caulking and associated miscellaneous material required.
 - 2. Include manufacturer's published data, letter of certification, or certified laboratory test report, indicating that each material complies with the requirements of the Contract Documents, and is intended for the uses and applications shown and/or specified.

1.04 QUALITY ASSURANCE

- A. All materials furnished and all work accomplished under the Contract shall be subject to inspection by the Engineer. The Contractor shall be held strictly to the true intent of the Specifications regarding quality of materials, workmanship, and diligent execution of the Contract.

- B. Work accomplished in the absence of prescribed inspection may be required to be removed and replaced under the proper inspection, and the entire cost of removal and replacement, including the cost of all materials which may be furnished by the City and used in the work thus removed, shall be borne by the Contractor, regardless of whether the work removed is found to be defective or not. Work covered up without the authority of the Engineer, shall, upon order of the Engineer, be uncovered to the extent required, and the Contractor shall similarly bear the entire cost of accomplishing all the work and furnishing all the materials necessary for the removal of the covering and its subsequent replacement, as directed, and approved by the Engineer.

1.05 GUARANTEE

- A. Provide guarantee against adhesive and cohesive failure of sealant and for water tightness of sealed joints for a period of five (5) years following date of final completion of work in this Section.

PART 2 MATERIALS

2.01 GENERAL

- A. General:
1. Only products certified as complying with the indicated requirements shall be provided.
- B. Products:
1. Products shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.
- C. Manufacturer's Recommendations:
1. Products shall be recommended by the manufacturer for the application indicated.

2.02 MATERIALS

- A. Acceptable Manufacturers:
1. Polyurethane Sealants:
 - a. Mameco International; Sika Chemical Corp.; Sonneborn- Contech; Tremco, Inc. (Dymeric); Pecora (Dynatrol I or Dynatrol II); or equal.
 2. Silicone Sealants:
 - a. General Electric Co.; Dow Corning Corp.; Pecora; or equal.
 3. Compressible Sealant:
 - a. Sandell Manufacturing Company, Inc., or equal.
- B. Sealants – General:
1. Provide colors matching materials being sealed. Where compound is not exposed to view in finished work, provide manufacturer's color which has best performance.

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2. Provide non-sagging sealant for vertical joints.
 3. Sealants for horizontal joints may be self-leveling.
 4. Before use of any sealant, investigate its compatibility with joint surfaces, fillers, and other materials in joint system. Use only compatible materials.
 5. Obtain sealing compounds from manufacturers who will provide manufacturers' field service representatives at project site for purpose of advising and instructing installers in proper procedures. Provide such services, at no expense to the Department.
 6. All Areas:
 - a. Polyurethane, or
 - b. Silicone.
 7. Use compressible sealant where indicated.
 8. Sealant materials shall be commercial grade products.
 9. Caulking tapes shall be of the butyl-base, vulcanized type.
- C. Sealant, Polyurethane:
1. One or two components.
- D. Sealant, Silicone:
1. One or two components.
- E. Joint Cleaner:
1. As recommended by sealant manufacturer and compatible with joint forming materials.
- F. Primer-Sealer:
1. As recommended by sealant manufacturer and to suit the application.
- G. Bond Breaker:
1. As recommended by sealant manufacturer and to suit the application.
- H. Sealant Backer Rod:
1. Rod stock of polyethylene, polyethylene jacketed polyurethane foam, or other flexible, non-absorbent, non-bituminous material recommended by sealant manufacturer to:
 - a. Control joint depth.
 - b. Break bond of sealant at bottom of joint.
 - c. Provide proper shape of sealant bead.
 2. Provide for joints greater than 3/16-inches wide.
 3. Manufacturer:

- a. Dow Corning Ethafoam, 5B; Sonnebourn, Sonofoam; or equal.

I. Sealant, Compressible:

- 1. Size so that width of material is twice joint width.
- 2. Foamed polyurethane strip saturated with polymerized polybutylene waterproofing on front face with non-reactive release agent that will act as bond breaker for applied sealant: Polytite-B, or equal.

J. Adhesive, compressible sealant:

- 1. Sandell No. 14, or equal.

PART 3 EXECUTION

3.01 GENERAL

A. General:

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

C. Authorized Installers:

- 1. Caulking and sealants shall be complete systems and shall be installed only by installers authorized and approved by the manufacturer.

3.02 PREPARATION

- A. Installer shall inspect the work to which sealants and/or caulking is to be applied and notify the Contractor in writing, with copy to the Engineer, of all conditions detrimental to the timely completion of the work. Do not proceed with the work of this Section until all unsatisfactory conditions have been corrected in a manner acceptable to the manufacturer of the materials.

B. Manufacturer's Representative:

- 1. The work includes the services of the sealant manufacturer's representative (prior to sealant work) for inspection of the joints and for instructing the installer in the proper use of the materials.

C. Surface Preparation:

- 1. Joints and spaces to be sealed shall be clean, dry, and free of dust, loose mortar, and other foreign materials. Ferrous metal surfaces shall be cleaned of rust, mill scale, and other coatings by wire brush, grinding, or sandblasting. Oil and grease shall be removed by cleaning in accordance with sealant manufacturer's recommendations. Protective coatings shall be removed from aluminum surfaces against which caulking or sealing compound is to be placed. Bituminous or resinous materials shall be removed from surfaces to receive caulking or sealants.

- 2. Sealant Dimensions:

- a. As indicated on the drawings or as required by the Engineer.

3. Joints in Porous Materials:
 - a. Where required by the manufacturer, sides of joints of porous materials shall be primed immediately prior to caulking or sealing.

3.03 INSTALLATION

- A. Seal building and any joints or areas which will permit penetration of moisture or access by insects or other pests. Make all joints water and airtight.
- B. Where required, prime joint surfaces. Limit application to surfaces to receive caulking. Mask off adjacent surfaces.
- C. Joints in Porous Materials:
 1. Where required by the manufacturer, sides of joints of porous materials shall be primed immediately prior to caulking or sealing.
- D. Make depth of sealing compounds not more than 1/2 width of joint, but in no case less than 1/4-inch (6 mm).
 1. Sub-caulk joints that are deep, or joints without suitable backstop, to proper depth.
 2. Protect side walls of joint (to depth of caulking) with Sandell No. 3 tape, or equal.
 3. Install with adhesive on 2 faces in contact with sides of joints.
- E. If joint is too shallow for use of backer rod, apply bond breaker to back of joint as recommended by sealant manufacturer. If bond breaker is used, apply it carefully to avoid prevention of sealant bond to sides of joints.
- F. A full bead of sealant shall be applied to the joint under sufficient pressure, with the nozzle drawn across sealant, to completely fill the void space and to ensure complete wetting of contact area to obtain uniform adhesion. During application, the tip of the nozzle shall be kept at the bottom of the joint to ensure forcing the sealant to fill from the bottom to the top.
- G. Sealants shall be tooled immediately after exposure with caulking tool or soft bristled brush moistened with solvent. The finished sealant filled joint shall be slightly concave unless otherwise indicated.
- H. In all rooms, seal all penetrations and recessed items through the floors, walls, and ceilings with concealed silicone sealant. This includes such items as electrical device cover plates, pipes, fire extinguisher cabinets, etc.

3.04 PROTECTION AND CLEANING

- A. Areas adjacent to joints to be sealed, shall be protected against smearing. Paper masking tape may be used if removed within ten minutes after the joint has been filled with sealant.
- B. Fresh compound that has been smeared on adjacent surfaces shall be immediately wiped off the surface with a clean rag, and all residue removed using methyl ethyl ketone, toluene, or other similar material, taking care not to damage the finish coating of the material being cleaned.

3.05 ENVIRONMENTAL CONDITIONS

- A. Do not proceed with installation of sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation.
- B. Proceed with the work only when forecasted weather conditions are favorable for proper cure and development of high early bed strength.
- C. Wherever joint width is affected by ambient temperature variations, install elastomeric sealants only when temperatures are in the lower third of manufacturer's recommended installation range, so that sealant will not be subjected to excessive elongation and bond stress at subsequent low temperatures.
- D. When high temperatures prevail, avoid mixing sealants in direct sunlight.

3.06 CLEANUP

- A. After application of sealant and caulking materials, adjacent materials which have been soiled shall be cleaned and left in a neat, clean, undamaged, or unstained condition. On porous surfaces, excess sealant shall be removed in accordance with the sealant or caulking manufacturer's printed instructions. All damage to surfaces resulting from the work of this section shall be cleaned, repaired, or refinished to the complete satisfaction of the Engineer at no additional cost to the Owner.

PART 1 GENERAL

1.01 SCOPE

- A. This section covers protective coatings, complete.

1.02 DEFINITIONS

- A. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.
- B. The term "DFT" means minimum dry film thickness, without any negative tolerance.

1.03 SUBMITTALS

- A. Submittals shall be furnished as specified herein and in accordance with the Technical Specification "Submittals".
- B. Coating Materials List
 - 1. Copies of a coating materials list showing the manufacturer and the coating number, keyed to the coating systems herein.
 - 2. Submit prior to or at the time of submittal of samples.
- C. Paint Manufacturer's Information. For each coating system to be used, include:
 - 1. Paint Manufacturer's data sheet for each product proposed, including statements on the suitability of the material for the intended use.
 - 2. Technical and performance information that demonstrates compliance with the system performance and material requirements.
 - 3. Paint Manufacturer's instructions and recommendations on surface preparation and application.
 - 4. Colors charts and samples/chips available for each product (where applicable).
 - 5. Compatibility of shop- and field-applied coatings (where applicable).
 - 6. VOC compliance.
 - 7. Material Safety Data Sheet for each product used.
- D. Coating applicator(s) qualifications and references.

1.04 AIR QUALITY REQUIREMENTS

- A. Coating materials, shop coating, and field coating shall comply with all applicable Glenn County Air Pollution Control Owner rules and regulations.

1.05 SURFACES NOT REQUIRING PAINTING

- A. The following areas or items are not required to be protective coated:

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1. Concrete Floors.
2. Masonry.
3. Portions of metal embedded in concrete.
4. Stainless steel, brass, bronze, chrome, or aluminum.
5. Machined surfaces (intended for a registered fit).
6. Grease fittings.
7. Glass.
8. Equipment nameplates.
9. Ferrous metal to be galvanized.
10. Switch plates, fixtures and certain other manufactured items furnished with an undamaged factory baked enamel finish.
11. Factory-finished electrical motor control panels (MCC) and main instrument panels (MIP), flow indicators, and related equipment.
12. Underground equipment
13. Plastic coated pipe insulation.
14. PVC or reinforced plastic piping.

PART 2 MATERIALS

2.01 GENERAL

- A. All materials, supplies, and articles provided shall, wherever practicable, be the standard product of recognized, reputable manufacturers. The standard products of manufacturers, other than those specified, will be accepted when it is proved to the satisfaction of the Owner that they are equal in composition, durability, usefulness, and convenience for the purpose intended. In any case, the Contractor shall demonstrate, to the satisfaction of the Owner, that all paint materials comply fully with the Specifications.
- B. All materials shall be delivered to the job in the manufacturer's unbroken packages with labels indicating the brand and contents of each container.
- C. Colors shall be as selected by the Owner from color chips supplied by the Contractor prior to the Contractor ordering the paint.
- D. Alternate coats of paint shall be tinted to ensure that all surfaces are properly coated with the specified number of coats. Unless otherwise specified, the colors of all undercoats shall match the color of the finish coat as nearly as practicable.
- E. All coatings in contact with potable water shall be NSF 61 approved.

2.02 MATERIALS

- A. Coatings

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1. Color shall be of pigments free of lead, lead components, or other materials which might be affected by the presence of hydrogen sulfide or other gasses likely to be present at Project.
2. Coatings shall meet surface burning characteristics as required by code and established by ASTM E84.
3. Gold galvanizing: field repair of hot dipped galvanized surfaces shall be a zinc rich coating that conforms to ASTM A780 and contains at least 94% pure metallic zinc in the dried film.
4. Polyamide Epoxy: Hi-build Epoxiline II, series 69 manufactured by the Tnemec company or approved equal, two coats 4 to 6 DFT each.
5. Zinc Rich Primer, Carbo Zinc 11 as manufactured by the Carboline Company, Tnemec-Zinc 901-97 as manufactured by the Tnemec Company, or approved equal. 3 mil DFT minimum.
6. Modified Polyamine Epoxy: Coatings used for interior surfaces of piping. For liquid epoxy-lined steel pipe, the coating material shall be liquid epoxy applied in accordance with ANSI/AWWA C210. TNEMEC Epoxoline Series 22, Carboline Carboguard 891, or equal, 16 mil DFT minimum total, unless otherwise specified.
7. Fusion Bonded Epoxy: Coating used for interior and exterior surfaces of piping. the coating material shall be a 100 percent powder epoxy applied in accordance with ANSI/AWWA C213. The coating shall be applied using the fluidized bed or electrostatic spray process. Coating DFT = 16 mils, Scotchkote 134 (electrostatic) or 206N (fluidized bed), or equal, applied in one coat, unless otherwise specified.
8. Polyurethane: not for emersion, Carboline 133HB as manufactured by the Carboline Company; Endura Shield 73 as manufactured by the Tnemec Company or approved equal, 3.0 DFT minimum unless otherwise specified.
9. Concrete floor of building interior: Rust-oleum 5010 water base acrylic or approved equal.
10. Concrete masonry surfaces shall be clear waterproofing, such as, Aquaseal as manufactured by the Monochem Company or approved equal.

2.03 MIXING AND TINTING

- A. Each coat shall be slightly darker than preceding coat, unless otherwise approved.
- B. Tint undercoats similar to finish coats.

PART 3 EXECUTION

3.01 SURFACE PREPARATION AND TOUCH-UP

- A. General:
 1. Comply with coating manufacturer's recommendations for surface preparation.
- B. Ungalvanized Ferrous Metal:
 1. General:

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- a. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
 - b. Prepare welds and adjacent areas to remove undercutting or reverse ridges on weld bead, weld spatter on or adjacent to weld or area to be coated, and sharp peaks or ridges along weld bead. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
 - c. Coat surfaces same day prepared. Re-prepare surfaces starting to rust before coating.
2. Cleaning Methods:
- a. Workmanship for metal surface preparation as specified shall conform with SSPC specifications as follows:
 - 1) SP-1: Solvent Cleaning
 - 2) SP-2: Hand Tool Cleaning
 - 3) SP-3: Power Tool Cleaning
 - 4) SP-5: White Metal Blast Cleaning
 - 5) SP-6: Commercial Blast Cleaning
 - 6) SP-7: Brush-off Blast Cleaning
 - 7) SP-8: Pickling
 - 8) SP-10: Near-White Blast Cleaning
 - 9) SP-13: Surface Preparation of Concrete
 - b. Wherever “solvent cleaning,” “hand tool cleaning,” “wire brushing,” or “blast cleaning,” or similar words of equal intent used in Specifications or coating manufacturer’s specifications, they shall be understood to refer to applicable SSPC specifications listed above.
 - c. Use hand tools to clean areas that cannot be cleaned by power tools.
3. Shop Preparation: Equipment, structural steel and similar items may be shop-prepared, and first coat applied at Contractor’s option. Centrifugal wheel blast cleaning is acceptable alternate to shop blast cleaning. Clean and prime in accordance with this section.
4. Field Touch-Up: Abrasive-blast items and equipment as specified to restore damaged surfaces previously shop or field blasted, and first coat applied. Materials, equipment, procedures, and safety equipment for personnel shall conform to SSPC.
- C. Galvanized Metal:
- 1. Touch-up damaged areas with zinc-rich primer.
 - 2. Prepare galvanized metal surfaces to be coated as required for system being applied.

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3.02 APPLICATION

A. General Requirements:

1. Apply coatings by brush, roller, spray, or other applicators according to manufacturer's instructions.

3.03 QUALITY CONTROL

A. Sampling of Materials:

1. The Owner reserves right to select unopened containers of materials furnished for project and have materials tested at an independent testing laboratory. The Owner will pay for first tests.
2. Retests of rejected materials and tests of replacement materials shall be paid for by the Contractor.
3. Remainder of contents of containers not required for testing will be returned to the Contractor.

B. Thickness Testing:

1. Thickness of coatings and paints shall be tested with a non-destructive film thickness gauge.

C. Holiday Testing:

1. Coating integrity of all interior coated surfaces of tanks and vessels shall be tested with an approved inspection device. All pinholes shall be marked, repaired in accordance with the manufacturer's printed recommendations and retested. No pinholes or other irregularities will be permitted in the final coating.

3.04 COATINGS SCHEDULE

A. General:

1. Coatings shall be applied in accordance with the manufacturer's recommendations.

B. Coating Schedule:

<u>Surfaces</u>	<u>Surface Preparation</u>	<u>1st coat</u>	<u>2nd coat</u>	<u>3rd Coat</u>
Exterior galvanized surfaces touch-up	Touch up damaged galvanizing per Section 05120 prior to top coating			
Ferrous surfaces of mechanical equipment previously shop primed or painted	SP-3	Touch up of finished coated surfaces with coatings provided by the manufacturer.		
Exposed ferrous surfaces and piping surfaces that are not galvanized, Note 3	SP-10	Zinc Rich Primer	Polyamide Epoxy	Polyurethane
Exposed surfaces of ductile iron pipe, Note 1	SP-1	None	none	Polyurethane

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<u>Surfaces</u>	<u>Surface Preparation</u>	<u>1st coat</u>	<u>2nd coat</u>	<u>3rd Coat</u>
Interior surfaces of ferrous piping, see Note 2	SP-10	Modified Polyamide Epoxy	Modified Polyamide Epoxy	Modified Polyamide Epoxy
Interior surfaces of welded steel tanks, Note 3	SP-10	Modified Polyamide Epoxy	Modified Polyamide Epoxy	Modified Polyamide Epoxy

Note 1, Exposed surfaces of ductile iron pipe to be coated shall have the seal coat removed prior to the application of any coatings.

Note 2, Interior surfaces of ferrous piping may be lined in accordance with Modified Polyamine Epoxy or Fusion Bonded Epoxy. Buried ductile iron pipe shall be cement lined and coated per technical specification titled “**Ductile Iron Piping**” or per technical specification titled “**Storm Drain and Fittings**”

Note 3, Interior and exterior steel tank shall be in accordance with AWWA D-102.

Note 4, Pump exterior shall be top coated with polyurethane.

C. Handling of Shop Primed Steel:

1. Contractor shall adhere to the following procedures and practices for handling, transporting, and storing shop primed steel:
 - a. Curing:
 - 1) Upon completion of blasting and priming operations, primer on plates and structural steel shall be cured sufficiently to minimize damage during handling.
 - b. Separation of Steel:
 - 1) When plates and structural steel are stored or transported, spacers and other protection shall be used to separate plates and structural steel, to eliminate primer being pulled off during unloading operations. If wood spacers are used, no splinters or wood particles will be allowed to remain in primed surfaces after separation.
 - c. Covering of Steel During Transit:
 - 1) Shop primed plate and structural members shall be covered 100 percent to prevent deposition of road salts, fuel residue and other contaminants, which may be present along the route of shipment to jobsite.
 - d. Load Binders:
 - 1) Loaded steel must be bound with padded chains or ribbon binders to minimize damage to coatings and paint during shipment.
 - e. Handling:

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1) Care shall be exercised during loading, unloading, storage and erection operations to minimize damage to primed steel. Sliding of steel across another plate or member will not be permitted, except for fitting sheets into position during roof construction.

f. Storage:

1) Primed steel plate and structural steel at jobsite shall not be placed on ground or on top of other steel work unless ground or steel work is covered with an approved covering. Steel may be elevated above ground level or other steel members by use of approved spacers.

D. Safety:

1. Contractor assumes the responsibility to accomplish all work in a safe and prudent manner, and to conform to all applicable safety requirements, regulations, and guidelines of federal, state, and local regulatory agencies, as well as applicable manufacturer's printed instructions and appropriate technical bulletins and manuals.

E. Ventilation:

1. Contractor shall ensure there are proper ventilation, air reduction, and exhausting of solvent vapors to reduce the concentration of air contaminants to a level which poses no hazard to personnel at or near the job site. Air circulation and exhausting of solvent vapors shall be continued until interior coatings and paints have fully cured. If conventional blast cleaning is accomplished, total containment during blast cleaning and coating and paint application operations is mandatory. The exhaust blower or dehumidification equipment capacity shall be sufficient to maintain air changes within containment interior in accordance with Cal/OSHA, coating and paint manufacturer's recommendations and local Air Quality Management Owner regulations, subject to Owner's review and acceptances.

F. Prior to erection of tank, all steel surfaces made inaccessible after erection (except underside of bottom plates) shall be cleaned as specified herein and shall receive the coating/paint system for the specific area. This includes, but is not limited to, metal to metal contact areas, e.g., bolted joints, tops of roof rafters, and inaccessible areas, e.g., interior of overflow pipe, stilling wells and interior/exterior of drain pipe.

G. After erection of tank, the roof plates located over roof rafters shall be lifted and the area made inaccessible after the roof plates are resting on the rafters shall be cleaned as specified herein and shall receive the coating/paint system for the tank interior, unless in the opinion of the Owner, the area in question is still inaccessible after lifting.

3.05 DEHUMIDIFICATION

A. Scope:

1. The interior of the tank shall be dehumidified continuously, 24-hours per day, during the cleaning and coating operations and during the final curing period.
2. The Contractor shall, at all times, maintain the concentration of solvent vapors in all parts of the structure ten percent below the lower explosive limit (LEL).

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- B. During the coating and cure phase, follow the coating manufacturer's recommendations for air temperature inside the tank.

3.06 FINAL CURING OF EPOXY COATINGS

- A. Upon completion and acceptance of applied coating system, Contractor shall furnish an approved exhaust fan or blower of sufficient capacity to insure removal of solvent vapors during curing process. The fan or blower shall remain in continuous operation until coating is completely cured as determined by the manufacturer of the coating system. Operation and maintenance of blower during curing operations shall be the responsibility of the Contractor.

PART 1 GENERAL

1.01 SCOPE

- A. This section covers the contract items Water Tank – Interior Coating and Water Tank – Exterior Coating and describes methods and procedures for coating (interior and exterior) and curing of coatings for steel tanks. The Contractor shall assign responsibility for erection, coating, cleaning, and disinfection as required for a complete installation ready for service. Refer to the Technical Specification “**Protective Coating**” for material and general workmanship requirements.
- B. Water Tank – Interior Coating includes:
1. Tank coating in accordance with the Technical Specification titled “**Protective Coating**,” as shown, and as specified herein.
 2. All steel pipe located inside of the tank in accordance with the Technical Specification titled “**Protective Coating**,” as shown, and as specified herein.
- C. Water Tank – Exterior Coating:
1. Tank coating in accordance with the Technical Specification titled “**Protective Coating**,” as shown, and as specified herein.
 2. Exterior overflow pipe, brackets/supports, and handrailing in accordance with the Technical Specification titled “**Protective Coating**”, as shown, and as specified herein.
- D. Painting systems shall be applied not sooner than seven days after completion of tank erection in accordance with the requirements of AWWA D102-14, the Steel Structures Painting Manual, Volume 2, published by the Street Structures Painting Council (SSPC), and as specified in the Technical Specification titled “**Protective Coating.**”
- E. Work to be accomplished includes application of protective coatings including surface preparation, handling of non-hazardous materials/wastes, and other Work necessary to accomplish the approved end result of a totally protected and usable structure, including attachments, accessories and appurtenances.
1. It is the intent of this specification that all interior and exterior surfaces above the bottom be abrasively blast cleaned and primed in the Fabricator's or Coating Contractor's shop.
 2. Final coatings shall be field applied.
- F. Prior to erection of tank, all steel surfaces made inaccessible after erection (except underside of bottom plates) shall be cleaned as specified herein and shall receive the coating/paint system for the specific area. This includes, but is not limited to, metal to metal contact areas (faying surfaces), e.g. bolted joints, tops of roof rafters and underside of column bases and inaccessible areas, e.g. interior of overflow pipe, stillingwells and interior/exterior of drain pipe.
- G. The Work to be included within this section consists of the furnishing of all materials, tools, equipment, and the necessary labor for coating and painting of the steel reservoir of the size and capacity shown, complete as shown on the Plans and specified herein.
- H. Provide materials, equipment and labor required to execute this Work as indicated on the Drawings, specified herein and necessary to complete the Work of this section.

- I. All items specified herein shall meet NSF 61 requirements where the product is used on potable water.

1.02 REFERENCES

- A. The following publications form a part of this specification to the extent referenced:

- 1. American Water Works Association (AWWAA):
 - a. AWWA D102-14 Coating Steel Water-Storage Tanks.
- 2. NSF International (NSF):
 - a. NSF 61 Drinking Water System Components.
- 3. Standard Specifications for Public Works Construction (SSPWC):
 - a. Standard Specifications for Public Works Construction.
 - b. Standard Plans for Public Works Construction.

1.03 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled **“Submittals,” “Protective Coating,”** and as specified herein.
- B. Contractor qualifications.
- C. Exhaust fan or blower of sufficient capacity to insure removal of solvent vapors during curing process.

1.04 QUALITY ASSURANCE

- A. Contractor Qualifications:
 - 1. The coating and painting Contractor shall be a licensed Painting and Decorating Contractor in the State of California (C-33 Classification) and shall have a minimum of ten (10) years practical experience and successful history in the application of specified products to surfaces of steel water storage tanks. The Contractor shall substantiate this requirement by furnishing a written list of references.
- B. General:
 - 1. Quality assurance procedures and practices shall be utilized to monitor all phases of surface preparation, application, and inspection throughout the duration of the Project. Procedures or practices not specifically defined herein may be utilized provided they meet recognized and acceptable professional standards and are approved by the Engineer.
- C. All materials furnished, and all Work accomplished under the Contract shall be subject to inspection by the Engineer. The Contractor shall be held strictly to the true intent of the Specifications in regard to quality of materials, workmanship, and diligent execution of the Contract.

- D. Work accomplished in the absence of prescribed inspection may be required to be removed and replaced under the proper inspection, and the entire cost of removal and replacement, including the cost of all materials which may be furnished by the Owner and used in the Work thus removed, shall be borne by the Contractor, regardless of whether the Work removed is found to be defective or not. Work covered up without the authority of the Engineer, shall, upon order of the Engineer, be uncovered to the extent required, and the Contractor shall similarly bear the entire cost of accomplishing all the Work and furnishing all the materials necessary for the removal of the covering and its subsequent replacement, as directed and approved by the Engineer.
- E. Except as otherwise provided herein, the cost for inspection will be paid by the Owner.
1. All surface preparation and priming operations accomplished offsite may be monitored 100 percent by an Owner appointed quality control inspector.
 2. The Contractor shall notify the Engineer a minimum of 14 days in advance of shop cleaning and priming operations.
 3. If shop work is not scheduled on a consecutive basis to facilitate scheduling of an offsite inspector, expenses incurred by multiple trips to shop will be borne by the Contractor.
- F. The Engineer will make, or have made, such tests as he deems necessary to assure the Work is being accomplished in accordance with the requirements of the Contract. Unless otherwise specified in the Supplementary General Conditions and General Conditions, the cost of such testing will be borne by the Owner. In the event such tests reveal non-compliance with the requirements of the Contract, the Contractor shall bear the cost of such corrective measures deemed necessary by the Engineer, as well as the cost of subsequent retesting and re-inspection. It is understood and agreed the making of tests shall not constitute an acceptance of any portion of the Work, nor relieve the Contractor from compliance with the terms of the Contract.

PART 2 MATERIALS

2.01 COATINGS

- A. Products are as specified in the Technical Specification “**Protective Coating.**”

PART 3 EXECUTION

3.01 GENERAL

- A. Thickness Testing:
1. Thickness of coatings and paints shall be tested with a non-destructive film thickness gauge.
- B. Holiday Testing:
1. Coating integrity of all interior coated surfaces shall be tested with an approved inspection device, Tinker & Razor wand or approved equal, 10,000 volts DC minimum. All pinholes shall be marked, repaired in accordance with the manufacturer's printed recommendations and retested. No pinholes or other irregularities will be permitted in the final coating.

C. Handling of Shop Primed Steel:

1. The Contractor shall adhere to the following procedures and practices for handling, transporting, and storing shop primed steel:
 - a. Curing:
 - 1) Upon completion of blasting and priming operations, primer on plates and structural steel shall be cured sufficiently to minimize damage during handling.
 - b. Separation of Steel:
 - 1) When plates and structural steel are stored or transported, spacers and other protection shall be used to separate plates and structural steel, to eliminate primer being pulled off during unloading operations. If wood spacers are used, no splinters or wood particles will be allowed to remain in primed surfaces after separation.
 - c. Covering of Steel During Transit:
 - 1) Shop primed plate and structural members shall be covered 100 percent to prevent deposition of road salts, fuel residue and other contaminants, which may be present along the route of shipment to jobsite.
 - d. Load Binders:
 - 1) Loaded steel must be bound with padded chains or ribbon binders to minimize damage to coatings and paint during shipment.
 - e. Handling:
 - 1) Care shall be exercised during loading, unloading, storage and erection operations to minimize damage to primed steel. Sliding of steel across another plate or member will not be permitted, except for fitting sheets into position during roof construction.
 - f. Storage:
 - 1) Primed steel plate and structural steel at jobsite shall not be placed on ground or on top of other steel work unless ground or steel work is covered with an approved covering. Steel may be elevated above ground level or other steel members by use of approved spacers.

D. Safety:

1. The Contractor assumes the responsibility to accomplish all Work in a safe and prudent manner, and to conform to all applicable safety requirements, regulations, and guidelines of federal, state, and local regulatory agencies, as well as applicable manufacturer's printed instructions and appropriate technical bulletins and manuals.

2. The overall Project Injury and Illness Prevention Program shall include tank access, lighting, coating, curing, ventilation, testing, and inspection in accordance with the Technical Specification section titled **“Submittals.”**
 3. During interior steel tank coating operations, Permit Required Confined Space safety requirements shall be in accordance with the Technical Specification section titled **“Site-Specific Safety Requirements.”**
- E. Ventilation:
1. The Contractor shall ensure there are proper ventilation, air reduction, and exhausting of solvent vapors to reduce the concentration of air contaminants to a level which poses no hazard to personnel at or near the job site. Air circulation and exhausting of solvent vapors shall be continued until interior coatings and paints have fully cured. If conventional blast cleaning is accomplished, total containment during blast cleaning and coating and paint application operations is mandatory. The exhaust blower or dehumidification equipment capacity shall be sufficient to maintain air changes within containment interior in accordance with Cal-OSHA, coating and paint manufacturer's recommendations and local Air Quality Management District regulations, subject to the Engineer's review and acceptances.
- F. Prior to erection of tank, all steel surfaces made inaccessible after erection (except underside of bottom plates) shall be cleaned as specified herein and shall receive the coating/paint system for the specific area. This includes, but is not limited to, metal to metal contact areas, e.g. bolted joints, tops of roof rafters, and inaccessible areas, e.g. interior of overflow pipe, stilling wells and interior/exterior of drain pipe.
- G. After erection of tank, the roof plates located over roof rafters shall be lifted and the area made inaccessible after the roof plates are resting on the rafters shall be cleaned as specified herein and shall receive the coating/paint system for the tank interior, unless in the opinion of the Engineer, the area in question is still inaccessible after lifting.

3.02 DEHUMIDIFICATION

- A. Scope:
1. The interior of the tank shall be dehumidified continuously, 24 hours per day, during the cleaning and coating operations and also during the final curing period. Except during the application of moisture cure zinc rich primer.
 2. The purpose of dehumidifying the interior of the tank during the cleaning and coating operations and during the final cure period is to nullify the adverse effects of cold and/or wet atmospheric conditions. Additionally, the dehumidification equipment will provide the necessary ventilation for the removal of solvent vapors during the coating and final cure phases. Dehumidification may be turned off at weekends depending on coating application and is subject to Owner approval.
 3. The Contractor shall, at all times, maintain the concentration of solvent vapors in all parts of the structure ten percent below the lower explosive limit (LEL).
- B. The processed air from the dehumidification unit must maintain a relative humidity of eleven percent (11%) or less.

- C. During the coating and cure phase, follow the coating manufacturer's recommendations for air temperature inside the tank.
- D. Air chillers, heaters, or air conditioners may be used downstream of the dehumidifiers if they are approved for use by the manufacturer of the dehumidification equipment.

3.03 FINAL CURING OF EPOXY COATINGS

- A. Upon completion and acceptance of applied coating system, the Contractor shall furnish an approved exhaust fan or blower of sufficient capacity to ensure removal of solvent vapors during curing process. The fan or blower, after approval by the Engineer, shall be installed as approved by the Engineer and shall remain in continuous operation until coating is completely cured as determined by the manufacturer of the coating system. Operation and maintenance of blower during curing operations shall be the responsibility of the Contractor. In the event of blower malfunction the Contractor shall be responsible for immediate repair of blower or furnishing of another operating blower until completion of curing operations.
- B. After completion of curing cycle as noted above, the Contractor shall test the applied coating via an "acetone wipe test" or "hardness test" to verify, to the Engineer, adequate curing has been attained. "Acetone wipe test" or "hardness test" requirements shall be as required by the coating manufacturer's written instructions.
- C. If final cure has not been attained, based on above tests, ventilation shall be continued until applied coating passes the "acetone wipe test" or "hardness test".
- D. After final cure is approved by the Engineer, the Contractor shall remove fan or blower.

3.04 CLEANUP

- A. Upon completion of the Work, all staging, scaffolding and containers shall be removed from the site to an approved refuse site in a legal manner. Coating, paint and thinner containers, and excess coating, spent abrasive blast material, paint and thinners, shall be disposed of in conformance to current regulations. Coating spots upon adjacent surfaces shall be removed and the entire jobsite cleaned. All damage to surfaces resulting from the Work of this section shall be cleaned, repaired, or refinished to the complete satisfaction of the Engineer at no cost to the Owner.

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Chemical feed system for the injection of Sodium Hypochlorite, Liquid Chlorination System.
 - 2. Chemical feed equipment includes chemical feed pumps and controls, solution feed lines and associated fittings, safety equipment, and related appurtenances for complete and operable systems.
 - 3. Electrical requirements to activate chemical feed metering pump when water distribution pump is operating.
- B. Design Requirements:
 - 1. Construction of all materials shall be resistant to chemicals to be used.
 - 2. Chemical feed pumps shall be specifically designed for the purpose of accurately metering and injecting the specified chemicals into the distribution system at the well houses.
 - 3. Chemical feed pumps shall be appropriately sized and configured to handle the required feed rates, anticipated system back pressures, and chemical composition of the treatment liquids.

1.02 REFERENCES

- A. The following publications form a part of this specification to the extent referenced.
 - 1. Occupational Safety and Health Administration (OSHA)
 - 2. American National Standard Institute
 - a. Ansi Z358.1-2014 American National Standard for Emergency Eyewash and Shower Equipment.

1.03 GENERAL REQUIREMENTS

- A. This work will be subject to the General Requirements and Covenants of the Contracts, requirements contained herein, and details shown on the plans. The Contractor shall provide all the labor, materials, tools, equipment, accessories and services necessary to install the items called for in the contract documents and will be responsible for producing a complete and workable installation in keeping with the intent of the contract.

1.04 SUBMITTALS

- A. The Contractor shall furnish shop drawings and product data in accordance with the General Conditions.
- B. Submit manufacturer's qualifications, product data, and shop drawings in sufficient detail to confirm compliance with the requirements of this section.

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1. Shop drawings shall indicate design details of the items to be furnished, their location and function in the project, finish, operating details, and other such information.
2. Submit product data and shop drawings in one complete submittal package. Partial submittals are unacceptable.
3. Product data and sizing/application documentation shall be submitted to the Engineer for approval prior to installation.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit in accordance with the General Conditions.
- B. Chemical feed pumps shall be accompanied with a standard installation package and preventative maintenance kit provided by the pump manufacturer.

1.06 TRAINING

- A. Contractor shall provide 4 hours of on-site training, excluding travel time, by the manufacturer's representatives. Training shall cover the operation and function off all systems installed. Training shall commence at a convenient time and date approved by the Owner.

PART 2 PRODUCTS

2.01 LIQUID CHLORINATION SYSTEM

- A. Self-Contained system with liquid storage tank with a peristaltic chemical feed pump and control panel mounted as a complete unit. The maximum size of chlorine containers shall be 40 gallons.

2.02 CHEMICAL FEED PUMPS

- A. Pump features:
 1. peristaltic type metering pumps
 2. self priming
 3. 100 psi maximum operating pressure
 4. 20:1 turndown ratio.
 5. Metering performance reproducible
 6. UL listed for outdoor and indoor use, CSA and NSF approved.
 7. Mounted interior of shed with HDPE wall mounting bracket
- B. All chemical feed pump connections shall be made as instructed by pump manufacturer and approved by the Engineer.
- C. Approved Manufacturers:
 1. Stenner SVP 4H1
 2. Blue White peristaltic pump Flex Pro A2
 3. Approved equal

2.03 COMBINATION DRENCH SHOWER, EYE AND EYE/FACE WASHER

- A. Freestanding, Pedestal Mounted, Plumbed combination Emergency Shower and Eyewash station meeting the minimum requirements of Acorn Safety, Morrill Group international model S2340 and as specified herein.

- B. Combination Emergency Shower and Eyewash Station shall be in accordance with OSHA 29 CFR 1910.151(c) and ANSI Z358.1-2014.
 - 1. Assembled and installed in accordance with manufacturer's instructions.
 - 2. Accessible location that requires no more than 10 seconds to reach.
 - 3. Eyewash shall be located on the same level as hazard and path of travel free of obstructions that may inhibit immediate use.
 - 4. Area around the eyewash shall be well lit.
 - 5. Connected to a supply of flushing fluid to produce the required spray pattern for a minimum period of 15 minutes.
 - 6. If the possibility of freezing conditions exists, the eyewash shall be protected from freezing or freeze-protected equipment shall be installed.
 - 7. If shut off valves are installed in the supply line for maintenance purposes, provisions shall be made to prevent unauthorized shut off.
 - 8. The actuating valve once activated the valve shall remain open without requiring further use of the operator's hands (single action operation)

- C. Materials
 - 1. Piping, Water Supply, and Waste Outlet:
 - a. Schedule 40 galvanized steel and 9-1/8-inch diameter cast iron floor flange with yellow powder-coated finish.
 - b. Water Supply: 1-1/4-inch female NPT threaded side or top inlet.
 - c. Waste Outlet: 1-1/4-inch female NPT outlet.

 - 2. Shower Head, Valve, and Actuator Arm:
 - a. 1-inch NPT chrome plated brass stay-open ball valve with a stainless steel actuator arm and standard length stainless steel pull arm.
 - b. Shower Head: 7-3/8-inch diameter, anti-microbial yellow ABS with a 20 gpm flow regulator.

 - 3. Eyewash Valve, Push-Handle, Bowl, and Spray-Head Assembly:
 - a. Valve: 1/2-inch NPT chrome-plated brass stay-open valve with a stainless steel push handle and a 50-mesh inline strainer.

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- b. Spray Heads: Anti-microbial ABS yellow plastic with integral dust covers and debris filters.
 - c. Bowl: 11-3/4-inch diameter anti-microbial yellow ABS
 - d. Auxiliary eye/face and body hose with anti-microbial ABS plastic eye/face wash spray head, self-closing squeeze lever valve, 96-inch-long reinforced PVC hose and pipe hook.
 - e. Include universal identification sign, ANSI compliant, and waterproof weekly test card.
- D. Approved Manufacturer
- 1. ACORN Safety; Morris Group International – Model S2340
 - 2. Encon Safety Products.
 - 3. Sellstrom Manufacturing Company
 - 4. Speakman Company
 - 5. Or equal

2.04 CHEMICAL FEED TANKS

- A. The chemical feed tanks supplied by the Contractor shall be compatible to store minimum 2 drums in the Contractor provided spill control drum shed for a total capacity minimum capacity of 60 gallons.
- B. The feed tanks shall also be compatible with the selected chemical feed pump and the chemical intended to be stored.
- C. Tank Features
- 1. Minimum 30 gallon tank
 - 2. Material Polyethylene
 - 3. Lid with child resistance lock (polypropylene)
 - 4. Grommets (Viton)
 - 5. Screws (Stainless Steel)
- D. Manufacturer:
- 1. Stenner STS30N-02

2.05 SPILL CONTROL DRUM SHED

- A. The Spill Control Drum shed shall be sized appropriately to store two drums and all pumping equipment, electrical, and appurtenances.
- B. Shed Features

1. Weather resistant
2. EPA and SPCC compliant
3. Leak proof pallet sump
4. Grounding capabilities
5. Capable of storing weight of equipment inside.

C. Manufacturer

1. Justrite – 2 Drum Drumshed with rolltop Doors (28675)
2. Or Equal

2.06 CHEMICAL FEED PIPING

- A. Chemical feed tubing for suction and discharge shall be designed to resist chemical being used.
- B. Chemical feed tubing shall be size and type recommended by pump manufacturer.
- C. All tubing connections shall be made according to pump manufacturer's instructions.
- D. Chemical feed conduit shall be 1-1/2-inch Schedule 80 PVC chemical conduit and shall be installed to accommodate all chemical feed lines within the pump house.
 1. The chemical feed conduit shall be painted yellow and labeled chemical conduit and tagged to identify the chemical carried.

2.07 CHEMICAL FEED INJECTOR ASSEMBLY

- A. Chemical Feed Injector Assembly shall be of type as recommended by the chemical feed pump manufacturer for the particular application described in this Section. Chemical feed injector shall be designed to withstand chemicals being used, pressures within the existing system, and supplied with a check valve. All connections shall be made per pump manufacturer's instruction and approved by the Engineer.
 1. The Chemical Feed Injector Assembly shall include the Corporation Stop, coupling assembly, nozzle assembly, safety cable, nylon bushing, check valve, and all associated piping as instructed by the manufacturer.
- B. Corporation Stops shall be Mueller H 15000 or approved equal. Corporation Stops shall accommodate the pump manufacturer's chemical feed injector of the size and location shown on the Drawings.

2.08 CHLORINE LIQUID

- A. 12 percent sodium hypochlorite.

2.09 ACCEPTANCE OF FINAL PRODUCT

- A. Installation of pumps and appurtenances shall be done by craftsmen skilled in their respective trades. Proper tools and appliances necessary for the safe and convenient handling and installation of the pumps and appurtenances shall be used. Pumps, scales, tubing, conduit and

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appurtenances shall be carefully examined for defects before installation. If a defective piece is discovered after being installed, it shall be removed and replaced at the Contractor's expense.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install equipment as shown on Drawings and as recommended by manufacturer's instructions.
- B. The chlorine chemical feed system is to be installed and operational, without leaks, with the approval of the Engineer before testing of connected systems is allowed.
- C. Chemical Feed System is inclusive of all items covered in this specification.

3.02 CHEMICAL FEED PUMPS

- A. Chemical feed pump shall be a self-contained unit with a separate liquid storage and mixing chamber.
- B. Chemical feed pumps shall be sized according to manufacturer's instructions and approved by the Engineer.

3.03 CHEMICAL FEED INJECTORS

- A. Installation of the Chemical Feed Injector Assembly into the line to be treated shall be as shown on the Drawings or as directed by the Engineer.

3.04 ELECTRICAL REQUIREMENTS

- A. Electrical requirements shall per Division 16 requirements and as specified herein.
- B. Contractor shall provide and install interlock and auxiliary relays so chemical feed pump operates when water distribution pump operates.
 - 1. Electrical work shall be performed by a State Licensed electrician.
 - 2. Chemical feed pump power requirements shall be provided by pump manufacturer.
 - 3. All labor, materials, tools, equipment, accessories, and services necessary to install all electrical systems shall be considered incidental to installing the Chemical Feed System.

<u>Schedule 1 to Section 11240</u> <u>Chemical Feed Pumps</u>	
Water Supply, gpm	2000 gpm
Discharge Pressure, psi	100
Turn Down Capability	20:1

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes Horizontal Split Case Pumps and Accessories for the:

1. Booster Pump.

1.02 SYSTEM DESCRIPTION

A. Design Requirements:

1. Pumps shall operate at specified capacities and heads over range of operating conditions without cavitation and undue noise and vibration.
2. Design equipment so parts are readily accessible for inspection and repairs, easily duplicated and replaced, and suitable for service required.
3. Equipment shall be free from shock, vibration, and noise under load conditions.
4. Bearings and similar parts shall have temperature rise not exceeding limit of safety and good practice for such parts.
5. Pumps and motors shall be designed for use with variable speed drive equipment and suitable for operation over a wide range of speeds.

1.03 QUALITY ASSURANCE

A. Each pump shall be dynamically balanced and factory tested. Submit certificate verifying that pump was balanced to within allowable standards and that pumping capacity is as specified.

B. Pumps, motors, variable speed drive equipment, drive shafts, couplings, and bearings shall be supplied from single supplier. Supplier shall verify existing site conditions and coordinate specific requirements for new equipment.

1.04 SUBMITTALS

A. Submit in accordance with the Technical Specification section titled **“Submittals.”**

B. General:

1. Submit Product Data and Shop Drawings in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

C. Shop Drawings:

1. Installation drawings and specifically prepared technical data for each pump application.
2. For Control Panels provided by pump manufacturer, include specially prepared wiring diagrams unless standard wiring diagrams are submitted with product data.
3. Control equipment.

D. Product Data:

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1. Catalog cuts and product specifications for each product specified.
 2. Pump Performance Curves and Data:
 3. Show head, capacity, hp demand, and pump efficiency curves from shut-off to maximum capacity of pump.
 4. Show head, capacity, hp demand, and pump efficiency for points specified in Schedule(s) attached.
 5. Proposed coating system. Submit in accordance with the Technical Specification titled **“Protective Coating.”**
 6. Standard wiring diagrams unless wiring diagrams are specially prepared and submitted as Shop Drawings.
 7. Catalog cuts and product specifications for control equipment.
- E. Test Results:
1. Submit factory certified performance curves to ENGINEER'S design office.
 2. Submit factory certified results of hydrostatic test to ENGINEER'S design office.
 3. Do not ship pumps to site until factory test results approved.
- F. Operation and Maintenance (O&M) Data.

1.05 PROJECT SITE CONDITIONS

- A. See Drawings for installation requirements of pumps.
- B. Critical dimensions to be reviewed and coordinated with new pump.
- C. All piping modifications required for installation of pumps are responsibility of the Contractor.

PART 2 PRODUCTS

2.01 HORIZONTAL SPLIT CASE PUMPS

- A. Manufacturers:
1. Goulds Pumps 3410 M Size 4x6
 2. Or Equal.
- B. General:
1. Horizontal split case pumps shall be a centrifugal pump specifically designed to pump water without clogging.
 2. The pumps shall be rated for continuous service and shall be bronze fitted construction suitable for pumping a liquid with the following characteristics:
 - a. Liquid: Water.
 - b. Specific Gravity: 1.

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- c. Temperature: 60° F.
- d. Viscosity of liquid: 1.122 cP.
- e. NPSHA: 30 ft.

C. Construction:

1. Casing shall be close-grained Cast Iron or Ductile Iron and shall be of axially-split double volute design with suction and discharge flanges and mounting feet cast integral with the lower half casing. Tapped and plugged holes shall be provided for priming, vent drain and gauge connections. Upper half casing shall be removable without disturbing suction or discharge piping.
2. The impeller shall be of the enclosed double suction type made of bronze and statically and hydraulically balanced. The impeller shall be keyed to the shaft and positioned axially by the shaft sleeves. Hub shall have sufficient metal thickness to allow machining for installation of impeller rings.
3. Shaft Sleeves shall be made of bronze and shall protect the shaft from wear and from contact with the pumped liquid. An O-ring shall be furnished under sleeve to prevent leakage.
4. Stuffing Box shall consist of at least five (5) rings of die formed, graphite acrylic yarn packing, a Teflon lantern ring, and a split type bronze gland to permit removal and access to packing. Ample space shall be provided for repacking the stuffing box. Arrangement shall provide for field or factory conversion to mechanical seals without machine work.
5. Casing Rings shall be made of bronze and shall be installed with an anti-rotation device.
6. Bearings shall be oil lubricated. The inboard or coupling end bearing shall be single row ball bearing. The outboard bearing shall be double row roller, selected to carry radial and thrust loads. The outboard bearing shall be retained by bearing locknut and lockwasher.
7. Bearing Housings shall be bolted to the end of the lower half casing and shall assure positive alignment of the rotating element. The housings shall provide a fit for the inboard bearing that allows freedom for thermal expansion while the outboard bearing shall be clamped in place to take all thrust loads and keep the rotating element in its proper axial locations.
8. Baseplate shall be sufficiently rigid to support the pump and driver and shall be steel with drip lip along the two sides, tapped drain and connections located on the pump end and the ends raised above the top surface. Final alignment of pump and driver shall be made after grouting and installation.

D. Testing:

1. The following non-witnessed tests are to be performed in accordance with Hydraulic Institute test standard:
 - a. Pump Performance A or B level.
 - b. Routine Motor Test.

- c. Hydrostatic – Complete Pump.

2.02 BOOSTER PUMP STATION

A. Horizontal Split Case Pumps

- 1. Each pump shall be capable of pumping and have a design point rating of 1000 US gpm when operating at a total pumping head of 208-feet.
- 2. The pump shall operate at 1780 rpm and shall have 78% minimum efficiency at the design point.
- 3. Rotation shall be counterclockwise when viewed from the driver end.
- 4. Pump shall be suitable for operation over a wide range of speeds.

B. Motor

- 1. The motor shall not be less than 100 HP 1800 RPM, NEMA Design B squirrel cage type, premium efficiency motor with 1.15 service factor and suitable for operation on 460 volts, 3 phase power, and with a variable frequency drive controller operating over a range of 40 to 60 hz.
- 2. Motor size shall be sufficient to prevent overloading at operating conditions or at the lowest listed head conditions, whichever point requires greater horsepower.
- 3. Following installation, grouting and connection of all piping, pump and motor must be checked for alignment in accordance with standards of the Hydraulic Institute and the manufacturer's installation instructions.

- C. Coatings and Linings shall be the manufacturers standard coatings suitable for the environment. The pump exterior surfaces shall be top coated with a polyurethane per Technical Specification titled "**Protective Coating.**"

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's written instructions and approved submittals.

3.02 FIELD QUALITY CONTROL

A. Manufacturer's Field Service:

- 1. Supplier's or manufacturer's representative for equipment specified herein shall be present at job site for minimum 5 man-days indicated, travel time excluded, for assistance during pump installation, startup, and training of the Owner's personnel. Include minimum of:
 - a. 2 man-day for Installation.
 - b. 2 man-day for Instructional and Startup Services.
 - c. 1 man-day for Post-Startup Services.

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section covers the contract item Prefabricated Building Structure (PBS).
- B. Provide materials, equipment and labor required to execute this work as indicated on the drawings, specified herein and necessary to complete the work of this section.

1.02 REFERENCES

- A. The following publications form a part of this specification to the extent referenced.
 - 1. American Society of Civil Engineers (ASCE):
 - a. ASCE 7-22 Minimum Design Loads for Buildings and Other Structures.
 - 2. American Society for Testing Materials (ASTM):
 - a. ASTM A 36 Specification for Carbon Structural Steel.
 - b. ASTM A 123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - c. ASTM A 153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - d. ASTM A 307 Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - e. ASTM A 325 Specification for High Strength Bolts for Structural Steel Joints.
 - f. ASTM A 500 Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - g. ASTM A 563 Standard Specification for Carbon and Alloy Steel Nuts.
 - h. ASTM A 653 Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - i. ASTM A 780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - j. ASTM C 1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).
 - k. ASTM D 1557 Standard Test Method for Laboratory Compacting Characteristics of Soil Using Modified Effort.
 - l. ASTM F 436 Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.

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- m. ASTM F 844 Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
- n. ASTM F 1554 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- 3. American Welding Society (AWS):
 - a. AWS D1.1 Structural Welding Code – Steel.
 - b. AWS D1.3 Structural Welding Code – Sheet Steel.
- 4. California Building Code (CBC).
- 5. Metal Building Manufacturers Association (MBMA):
 - a. Metal Building Systems Manual.

1.03 SUBMITTALS

- A. Shop drawings shall be submitted in accordance with technical specifications titled “**Submittals**”.
- B. Shop drawings submitted shall be coordinated to show all components, including accessories; structural calculations; material descriptions; finishes; fastenings; methods of joining; and sealants. All shop drawings shall be stamped and signed by a registered professional Civil or Structural Engineer, licensed to practice in the State of California. The shop drawings shall include, as a minimum, the following Drawings:
 - 1. Drawings showing revisions to foundation and footing dimensions to those shown on the Contract Documents.
 - 2. Foundation anchor bolt plan with anchor bolt, shear angle (if required), and baseplate details for this project. A diagram shall be included showing the vertical and lateral loads applied on the foundation at each column for each load combination.
 - 3. Erection drawings for the structural steel frame.
 - 4. Transverse cross sections.
 - 5. Roof plan showing sizes and locations of all structural members and bracing.
 - 6. Elevations showing sizes and locations of all structural members, bracing.
 - 7. Calculations shall include a complete structural stress and deflection analysis of all structural components and connections. Should the building design propose bolted moment-resistant connections in the main frames, the prying action of the bolts shall be considered in the design. If computer programs are utilized in the preparation of calculations, the programs' operational premises shall be submitted along with the output data.
 - 8. Warranty information.
- C. Manufacturer's Information:
 - 1. Manufacturer's complete technical literature, building system description, and maintenance instruction shall be submitted to the Engineer.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: The manufacturer of the prefabricated building structure shall have not less than five (5) years successful experience in the design and fabrication of prefabricated building structures of the type and quality required.
- B. Welding:
 - 1. Qualify procedures and personnel according to the following:
 - a. All welding shall be in accordance with ANSI/AWS D1.1, "Structural Welding Code-Steel" (with E70XX Electrodes).
 - b. All structural shop welding shall be done by currently certified welders.
 - c. Steel shop connections will be welded, and field connections will be bolted unless otherwise noted on plans.
 - d. All slag shall be cleaned from all welds and inspected.

1.05 PROJECT CONDITIONS

- A. Field Measurements:
 - 1. The Contractor shall verify actual locations of walls, columns, and other construction contiguous with pre-engineered metal building by field measurements before fabrication and indicate measurements on Shop Drawings.

1.06 PERFORMANCE REQUIREMENTS

- A. Structural Performance:
 - 1. Provide a pre-engineered steel building structure capable of withstanding the effects of all forces as outlined in CBC.

1.07 GUARANTEE

- A. The manufacturer shall warrant that the materials furnished will be free from defects in material and workmanship on the shipment date and further warrant that it will correct, by repair or replacement, any such defect within one (1) year from the shipment date.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver anchorage devices that will be embedded in the work of other trades in sufficient time to permit their timely installation. Provide proper setting, drawings, templates, and directions for installation.
- B. Store materials above ground on platforms, skids, or other supports. Store all fasteners and welding electrodes in a weather tight and dry location until ready for use. Store packaged materials in their original labeled containers.

PART 2 PRODUCTS

2.01 GENERAL

- A. The prefabricated building structure shall be provided complete with structural framing, wall, and roof panel systems and all necessary trim and accessories.
- B. Structural System:
 - 1. The building's structural system shall consist of steel frames with bracings as required. The steel liner panel of the roof shall be designed as a roof diaphragm for load transfer.

2.02 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by the manufacturers specified:
 - 1. American Carports, Inc
 - 2. Allied Steel Company, Inc.
 - 3. Austin Mohawk and Company, Inc.
 - 4. Butler
 - 5. Varco-Prudent Buildings, Inc.
 - 6. Or approved equal

2.03 DESIGN CRITERIA

- A. Design Loads, including wind and seismic loads, shall be per CBC Building Code.
- B. Design Requirements:
 - 1. Design primary and secondary structural members and exterior covering materials for applicable loads and combinations of loads in accordance with CBC.
 - 2. For design of structural steel members, comply with the requirements of AISC 360-22.
 - 3. Welded connections shall comply with AWS.

2.04 PRE-ENGINEERED STEEL BUILDING STRUCTURE

- A. Frames:
 - 1. Frames and bracing shall be fabricated from hot rolled structural steel or heavy gauge steel (12 gauge minimum) as determined by the manufacturer.
- B. Roof Style:
 - 1. A-Frame Vertical, roof trusses, 4/12 pitch, 6-inch overhang.

2.05 SHEET METAL ACCESSORIES

- A. General:

1. Provide galvanized steel sheet metal 26 gauge minimum, accessories with galvanized steel roofing and wall panels. Kynar or backed enamel factory finish.
2. Seal roof panels, wall panels, door framing and flashing with butyl rubber or the manufacturers standard sealant.
3. Fasteners per the manufacturers standard, coated to match the trim or panel color.

B. Trim:

1. Trim shall be per the manufactures standard.

2.06 MISCELLANEOUS

A. Insulation:

1. R16 Bubble Insulation on roof and exterior walls.

B. Roll-up Door:

1. 10-foot by 8-foot

C. Personnel Doors:

1. Exterior doors Steel Heavy Duty doors 36-inch by 84-inch.
2. Interior doors manufacturers standard.
3. Aluminum thresholds

D. Panic hardware

E. Louvered Vents

1. Install along the perimeter of the pump building 24-inches above ground.
2. Total amount of ventilation required in accordance with California Building Code
3. Minimum size 24-inch by 12-inch

2.07 FABRICATION

A. General:

1. Design prefabricated components and necessary field connections required for erection to permit easy assembly.
 - a. Clearly and legibly mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.

PART 3 EXECUTION

3.01 FABRICATION

- A.** All material shall be completely fabricated and prepared for shipment including any necessary crating or bundling. All parts of the building shall be accurately made and true to dimension so that all parts will easily fit during erection.

3.02 ERECTION

- A. Erect structural framing true to line, level and plumb, rigid, and secure

3.03 ROOFING AND WALL PANELS

- A. General:
 - 1. Installation of roof and wall panels shall be in accordance with the manufacturer's recommendations and installation instructions. Avoid "panel creep" or application not true to line. Protect factory finishes from damage.

3.04 CLEANING

- A. Keep premises free from accumulated waste materials, rubbish and debris resulting from work herein, and, upon completion of said work, remove tools, appliances, surplus materials, waste materials, rubbish, debris, and accessory items used in or resulting from said work, and legally dispose of off-site.
- B. Protect work and materials of this Section prior to and during installation and protect the installed work and materials of other trades.

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section covers the contract item Water Tank – Cathodic Protection System and describes the requirements for all components of the cathodic protection system for the steel water storage tank including magnesium anodes, cables, junction boxes, reference electrodes, and any other work necessary to complete the installation. The intent of the specification is to provide for a complete, functional cathodic protection system for the submerged interior surfaces of the steel water storage tank.
- B. Water Tank – Cathodic Protection System includes:
1. The water storage tank shall include a direct connect galvanic cathodic protection system. The specific design shall be prepared by an Owner approved Corrosion Engineer and submitted by the Contractor prior to construction for review. Generally, the system shall consist of sacrificial anodes hanging from the tank roof accessed by roof handholes. The anode control box shall be located at the bottom of the tank for easy access as specified herein;
 - a. Cathodic protection of the submerged portion of the tank interior surfaces;
 - b. Material submittals;
 - c. Shell penetrations and anode and reference cell access ports;
 - d. Installation of magnesium anodes, cables, reference cells and anode control box;
 - e. Repairs to tank roof coating;
 - f. Connecting the anodes and testing;
 - g. All accessories required for a complete operable cathodic protection (CP) system; and.
 - h. Correction of all deficiencies.
- C. Anodes, anode lead wires, header cables and conduit lengths shown on the plans are for informational purposes only. Actual quantities and lengths are the responsibility of the Contractor and are based on installation requirements to install the Corrosion Engineer designed water storage tank cathodic protection system.
- D. The Contractor shall retain a qualified Corrosion Engineer (a qualified Corrosion Engineer is a Registered Professional Corrosion Engineer in the State of California) to design the water storage tank cathodic protection system and direct, oversee, and inspect the construction of facilities specified herein. The Corrosion Engineer shall design, test, and certify that the corrosion control facilities for this project are constructed properly and as specified, and are fully functional.
- E. Provide materials, equipment and labor required to execute this work specified herein and necessary to complete the work of this section.

- F. All items specified herein shall meet NSF 61 requirements where the product is used on potable water.

1.02 REFERENCES

The following publications form a part of this specification to the extent referenced.

- A. Federal Specifications
 - 1. TT-S-001543A Sealing Compound, Silicone Rubber Base, (For Caulking, Sealing and Glazing in Buildings and Other Structures).
 - 2. TT-S-00230C(2) Sealing Compound, Elastomeric Type, (For Caulking, Sealing, and Glazing in Buildings and Other Structures).
- B. NSF International:
 - 1. NSF 61 Drinking Water System Components.

1.03 SUBMITTALS

- A. Submit in accordance with Technical Specification section titled “**Submittals.**”
- B. Water storage tank cathodic protection system designed by an Owner approved Corrosion Engineer.
- C. Catalog cut sheets:
 - 1. Magnesium Anodes (20-feet, Standard Potential).
 - 2. Wire and Cable.
 - 3. Wire Splice Materials or Kits.
 - 4. Anode Access Ports (by parts).
 - 5. Permanent Reference Cells.
 - 6. Reference Cell Access Ports (by parts).
 - 7. Wire Insulators/Hangers.
 - 8. Anode Control Box.
 - 9. Shunts.
 - 10. Conduit.
 - 11. At-Grade, Traffic-Rated Concrete Test Box With Cast Iron Lid.
 - 12. Flange Isolation Kits.
 - 13. External Coating for Buried Non-Mortar Coated Surfaces.
 - 14. Exothermic Weld Kits and Charges.
 - 15. Weld Caps and Primer.
 - 16. Weld Coating.
 - 17. Plastic Warning Tape.

- 18. Wire Identification.
- D. Qualifications of the Contractor's Corrosion Engineer.
- E. Corrosion Engineer's test procedures, test data, and detailed written report describing any deficiencies detected.
- F. The Contractor shall submit as-built drawings (marked-up drawings) showing the actual locations of all anode and reference cell ports, tank penetrations, conduit, and anode control box enclosure. As-built drawings shall be received by the Engineer before the work is considered complete. Any changes shall be clearly marked in red.

1.04 QUALITY ASSURANCE

A. General:

- 1. Quality assurance procedures and practices shall be utilized to monitor all phases of surface preparation, application and inspection throughout the duration of the project. Procedures or practices not specifically defined herein may be utilized provided they meet recognized and acceptable professional standards and are approved by the Engineer.
- 2. All materials furnished, and all work accomplished under the Contract shall be subject to inspection by the Engineer. The Contractor shall be held strictly to the true intent of the Specifications regarding quality of materials, workmanship, and diligent execution of the Contract.
- 3. Work accomplished in the absence of prescribed inspection may be required to be removed and replaced under the proper inspection, and the entire cost of removal and replacement, including the cost of all materials which may be furnished by the Owner and used in the work thus removed, shall be borne by the Contractor, regardless of whether the work removed is found to be defective or not. Work covered up without the authority of the Engineer, shall, upon order of the Owner, be uncovered to the extent required, and the Contractor shall similarly bear the entire cost of accomplishing all the work and furnishing all the materials necessary for the removal of the covering and its subsequent replacement, as directed and approved by the Owner.

B. Corrosion Engineer Qualifications:

- 1. The Contractor shall retain a qualified Corrosion Engineer (a qualified Corrosion Engineer is a Registered Professional Corrosion Engineer in the State of California) to design the water storage tank cathodic protection system and direct, oversee, and inspect the construction of facilities specified herein. The Corrosion Engineer shall design, test, and certify that the corrosion control facilities for this project are constructed properly and as specified, and are fully functional.
- 2. The Corrosion Engineer shall have a minimum of ten (10) years practical experience and successful history in the design, inspection, and testing of water storage tank cathodic protection systems of similar size and scope. The Contractor shall substantiate this requirement by furnishing a written list of project references.

PART 2 MATERIALS

2.01 GENERAL

A. General:

1. Materials and equipment furnished under this section of the specifications shall be the standard product of manufacturers regularly engaged in the manufacturing of such products and shall be the manufacturer's latest standard design that complies with specification requirements. All materials and equipment shall bear evidence of U.L. approval when U.L. standards exist.

B. Magnesium Anodes:

1. Anodes shall be extruded magnesium alloy rods in accordance with ASTM B 107 with a steel wire core. The standard potential magnesium alloy shall have a theoretical energy capacity of 1000 ampere-hours per pound and have a nominal useful capacity of 500 ampere-hours per pound.
2. Each anode shall conform to the following chemical composition. The open circuit potential of the anode shall be between 1.40 and 1.50 volts versus a copper/copper-sulfate reference electrode.

Aluminum	2.5 – 3.5%
Manganese	0.20%, Min.
Zinc	0.7 – 1.3%
Silicon	0.05%, Max.
Copper	0.01%, Max.
Nickel	0.001%, Max.
Iron	0.002%, Max.
Other impurities (each)	0.05%, Max.
Other impurities (total)	0.30%, Max.
Magnesium	Balance/remainder

3. Anodes shall have an outside diameter of 2.024-inches and a nominal weight of 2.5 pounds per linear foot. Lengths shall be as determined by the Corrosion Engineer. The steel wire core shall be 3/16-inch diameter.
4. The anode lead cable shall be attached to the steel wire anode core with suitable brass crimp connector. The connection shall be silver soldered or brazed. The connection shall be insulated with a heat shrink; mastic filled sleeve. The sleeved connection and 2 inches of the anode shall be fully encapsulated with a PVC cap filled with potting epoxy.

C. Anode and Reference Cell Access Port Assembly

1. Construction:

- a. The anode port assembly shall be fabricated from the following materials:
 - SS Clevis;

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- Porcelain Roller;
- 1/16-inch Neoprene Washer;
- 1/16-inch Nut, Bolt, and Washer;
- Wire U-clamp.

2. All metallic materials shall be Type 316 stainless steel.

D. Access Handholes

1. Construction:

- a. The access handholes shall have a 6-inch diameter cover for a 5-inch diameter access hole.
- b. The cover shall be 10 Ga. Type 316 stainless steel. The ring gasket shall be 1 inch wide by 1/8-inch-thick neoprene with a 5-inch diameter ID. The 1/12 inch by 1-inch-long stainless steel bolt and stainless steel nuts and washers shall be as shown on the Drawings.

2. Grommet seal:

- a. All access handholes shall have a NSF 61 compliant, UV resistant rubber grommet seal. Use DiveCorr Linear Grommet, or equal.

E. Anode Control Box

1. Type:

- a. Use Corpro CorrPower Magnesium Anode Controller, or equal.

2. Enclosure:

- a. Fiberglass, NEMA 4X, rain tight enclosure. The enclosure shall have a hinged door with a lock hasp. All hinges and fasteners shall be stainless steel.

3. Anode Control Box Location/Installation:

- a. The anode control box shall be mounted adjacent to the tank ring wall at ground elevation and below the tank penetration for cathodic protection cables (located just below the radial line or "knuckle" of the tank).
- b. The box shall be mounted on a 2-inch by 6-foot galvanized steel post. The steel post shall be installed in the ground to a depth of 2-feet and shall be encased in concrete with a diameter of 24-inches. The post and test box shall extend above grade by 4-feet.
- c. Unistrut attached to the tank may be used in lieu of the steel post with prior written approval from the Engineer.

F. Copper Sulfate Reference Electrode (Permanent)

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1. General Requirements:
 - a. Copper sulfate reference electrodes (or cells) shall be constructed with an ion trap to prevent contamination. The reference electrode shall have a design life of 15 years and a stability of +/-5 millivolts under a 3.0-microampere load.
 2. Reference Electrode Wires:
 - a. Provide each reference electrode with a No. 14 AWG THWN lead wire. The cells shall have red insulation. For reference cells installed inside tank, each lead wire shall be long enough to extend from the electrode to the anode resistor box without any splices. For buried reference cells installed inside tank, each lead wire shall be long enough to extend from the pipe trench to the test box without any splices.
 3. Type:
 - a. Use STAPERM Model CU-2-FW, or equal.
- G. Wire and Cable
1. All Wire:
 - a. All wire shall be single conductor, stranded copper of the gauge indicated. Wire sizes shall be based on American Wire Gauge (AWG). Copper wire shall be in conformance with ASTM Standards B 3 or B 8.
 - b. Wire with high molecular weight polyethylene (HMWPE) insulation and shall conform to the requirements of ASTM D 1248 Type 1, Class C, Grade 5.
 - c. Wire with THWN insulation shall conform to the requirements of ASTM D 2220.
 2. Anode Lead Wire:
 - a. The anode lead wires shall be No. 8 AWG HMWPE. Each anode shall have a lead wire of sufficient length to reach from the anode to the splice to the header wire without a splice.
 3. Cable Lengths:
 - a. Anodes shall be provided with sufficient cable length to effect the installation. Provide at least 3-feet of excess cable.
 4. Header Wire:
 - a. No. 6 AWG with HMWPE insulation.
 5. Tank Lead Wire:
 - a. No. 8 AWG with HMWPE insulation.

- 6. Pipeline Bond Wires:
 - a. No. 6 AWG with HMWPE insulation.
- 7. Reference Cell Lead Wire:
 - a. No. 14 AWG with RHH-RHW insulation.
- H. Wire Hangers and Connection Hardware
 - 1. Insulators (Wire Hangers):
 - a. The anode header cable shall be secured to the tank roof with a porcelain insulator with an embedded steel threaded stud which is bolted to the tank roof plates. A 1/16-inch-thick neoprene gasket shall be placed between the insulator and the inside of the roof plate to completely seal the crevice. The insulators shall be fastened with stainless steel washer and two nuts.
 - 2. Support Hardware and Fasteners:
 - a. All bolts, washers and wire support hardware shall be 316 stainless steels.
 - 3. Wire Connectors:
 - a. Wire splices shall be made with brass crimp connectors specifically sized for the wire sizes being spliced.
 - 4. Splice Encapsulation Materials:
 - a. All wire splices shall be encapsulated in a watertight seal made with butyl rubber electrical putty and vinyl plastic tape. Pre-manufactured splice kits using molds and epoxy potting compounds can be submitted as an alternate for approval by the Engineer.
- I. Conduit and Conduit Fittings
 - 1. Conduit and Fittings:
 - a. Conduit and fittings shall be hot-dipped galvanized steel and shall conform to ANSI Specification C80.1 for Rigid Metallic Conduit and Division 16 of these specifications.
 - 2. Conduit Seal:
 - a. Provide 6 inches of expandable liquid foam sealant from the tank shell penetration so that no condensation or water can penetrate the conduit. Additionally, threaded conduit shall have thread seal to prevent moisture intrusion.
- J. Exothermic Weld Kit

1. Wire Connections:
 - a. Wire-to-metal connections shall be made by the exothermic welding process. Weld alloy shall be for steel pipe. It is the Contractor's responsibility to determine the manufacturer's recommended weld charge size for metallic surfaces.

K. Weld Caps and Primer

1. Weld Caps:
 - a. Exothermic welds shall be sealed with a prefabricated plastic cap filled with formable mastic compound on a base of elastomeric tape. Weld caps shall be Royston Handy Cap or equivalent.
2. Weld Primer:
 - a. Weld cap primer shall be an elastomer-resin based corrosion resistant primer for underground services such as Royston Roybond Primer 747 or equivalent.

L. Weld Coating

1. Coating:
 - a. All exothermic weld caps shall be over-coated with a cold-applied fast-drying mastic consisting of bituminous resin and solvents per MIL-C-18480B.
 - b. Apply to at least 25 mils thickness.
 - c. Koppers Bitumastic 50 or 505, Tnemec 40-H-413, Tape-coat TC Mastic, 3M Scotch Clad 244, or equal.

PART 3 EXECUTION

3.01 ANODE STORAGE

- A. Anode Handling and Storage:
 1. Care must be taken to prevent damage or bending of the anodes during shipment, handling and storage. The Contractor shall store the anodes at ground level on three (3) wood 4x4s equally spaced until they are ready to be installed. Lead wires and hardware (stainless steel thimbles, U-bolts, etc.) shall be neatly bundled and stored with the anodes.
- B. Weather Protection:
 1. Anodes shall be fully encased with two layers of 8-mil polyethylene sheet. Seal the wrap with tape.
- C. Location:
 1. Anodes shall be stored at a location directed by the Owner.

3.02 HARDWARE INSTALLATION SEQUENCE

A. Access Ports:

1. Anode and reference cell access ports shall be installed and all cutting and welding shall be done before the tank is painted or coated.

B. Header Wire Hangers:

1. Install all anode header wire suspension hardware after the roof is painted and coated but before the tank is put into service. Holes for insulated cable hangers shall be carefully placed so that there is minimum coating damage. Provide rubber or waterproof gasket between the insulator and the roof on the inside and between the metal washer and the roof on the outside.

C. Conduit, Wiring and Hardware:

1. All remaining cathodic protection wiring, conduit and hardware (except for the anodes) including: the anode header and feed wire; anode pigtails and splice; hanger\insulators; conduit; tank penetrations; enclosures with all internal components; anode header-to-feed wire splice; and supporting hardware is to be installed and approved before the tank is put into service.

D. Anode Pigtails:

1. The Contractor shall splice anode pigtails to the header wire. The pigtail shall be long enough to loop up through the access port and extend beyond the port by 30 inches minimum. The pigtail shall be secured to the stainless steel clevis and porcelain roller for easy access when the anodes are installed at a later date.

E. Anode Lead Wire Termination:

1. The exact length of cable from the epoxy anode cap to the thimble shall be determined in the field. Note that the bottom tip of the anode shall be suspended at a distance from the tank bottom as determined by the Corrosion Engineer. The Contractor shall allow enough anode lead wire to extend above the roof by 30 inches minimum after the anode is suspended.

F. Splice:

1. All wire splices shall be watertight and suitable for long-term exposure to moist and humid conditions. Copper conductor connections shall be made with a brass crimp connector. The watertight covering shall consist of several layers of butyl rubber electrical putty and at least 6 layers of half-lapped vinyl electrical tape. Alternate splice methods, such as splice kits, will be considered and must be approved by the Engineer before use.

3.03 ANODE AND REFERENCE CELL PORT ASSEMBLY

A. Location:

1. The approximate location of the anode and reference cell port assemblies is shown on the Drawings. Final locations shall be determined in the field after the new roof is in place. The port locations shall be adjusted to avoid roof beams and rafters. Reference

cells and reference cell ports shall be placed as close as possible to the mid-point between the two closest anodes.

2. The Contractor shall record final port locations on as-built Drawings.

B. Roof Holes:

1. Roof holes for anode and reference cell ports shall be cut in accordance with AWWA D100. No structural members shall be cut. All cut edges shall be ground smooth. Hole diameters shall be 5 inches for anode ports and 5-inches for the reference cell ports.

C. Access Handhole Grommets:

1. Use DiveCorr Linear Grommets, or equal. Install per the manufacturer's recommendations.

D. Coating Repairs:

1. All cutting and welding shall be done prior to coating and painting the tank. Any damaged coating resulting from the installation of header wire hangers or any other cathodic protection component shall be hand cleaned with wire brushes and abrasive paper and fully coated with a material compatible with the tank coating or paint.

3.04 ANODE CONTROL BOX

A. Junction Box:

1. The anode control box shall be installed on the exterior tank wall with suitable brackets welded to the tank. Exact location of test station shall be determined in the field. All welded brackets must be painted with the tank exterior. Field route conduit to tank penetration and to ring wall penetration for exterior reference cells. Two tank test lead wires shall be welded to the tank bottom ring wall and routed to the anode control box. The terminal end of each cable shall be identified with the structure identification using the permanent cable identification tags.

3.05 WIRE, CABLE AND CONDUIT

A. Anode Pre-Assembly:

1. All anode lead wires shall be connected to the anode by the anode supplier in accordance with the Drawings. Alternate lead wire connections can be submitted to the Engineer for consideration and approval.

B. Header Wire and Tank Penetrations:

1. The header wires shall be suspended from the tank roof from insulators. The header wire shall be spliced to form a continuous loop and shall be spliced to the anode feed wire from the anode junction box. The anode feed wire shall penetrate the tank shell above the high-water line. All wiring shall be done in accordance with the National Electrical Code NFPA 70.

C. Wire Chafe Protection:

1. Wire chafing shall be prevented by securing anode header, feed or pigtail wires to the roof structure at all points where the wire contacts the structure. A galvanized C-clamp shall be used for this purpose.

D. Conduit:

1. All conduit placed on the outside of the tank shall be spaced off the tank with clamps and non-metallic spacers as shown on the Drawings. Additionally, threaded conduit shall have thread seal to prevent moisture intrusion.

E. Damaged Wire:

1. Care shall be taken when handling and installing wire so that the insulation is not stretched, kinked or cut. If wire insulation is damaged during installation, it shall be repaired with a fully watertight seal. Wire insulation repairs shall be observed and approved by the Owner or Engineer.

3.06 WIRE TO METAL CONNECTION

A. Connection Method:

1. All connections of lead wires to the tank/pipe shall be made by the exothermic weld method. Coating materials shall be removed from the tank surface over an area just sufficient to make the connections. The surface shall be cleaned to white metal by grinding or filing prior to welding the conductor. Grinding with resin impregnated wheels shall not be allowed. All exposed surfaces of copper and steel shall be covered with a minimum thickness of 1/4-inches of insulating materials. Deviations from this connection method require the written approval of the Engineer.

B. Weld Charge Size:

1. It is the Contractor's responsibility to ensure that the manufacturer's recommended weld charge size is used.

C. Preparation of Wire:

1. Do not deform cable. Remove only enough insulation from the cable to allow for the exothermic weld.

D. Preparation of Metal:

1. Remove all coating, dirt, grime and grease from the metal structure by wire brushing. Clean the structure to a bright, shiny surface free of all serious pits and flaws by using a file. The surface area of the structure must be absolutely dry.

E. Wire Position:

1. The wire is to be held at a 30 degree angle to the surface when welding. Only one wire shall be attached with each weld.

F. Testing of Completed Welds:

1. After the weld has cooled, the weld shall be tested by striking the weld with a 2 pound hammer while pulling firmly on the wire. All unsound welds shall be cleaned, re-welded, and re-tested. All weld slag shall be removed.

G. Coating of Welds:

1. The area to be coated shall be clean and completely dry. Apply a primer specifically intended for use with an elastomeric weld cap. Apply the weld cap and a bituminous mastic coating material to all exposed areas around the cap in accordance with the manufacturer's recommendations. The coating shall overlap the structure coating by a minimum of 3-inches.

3.07 INSPECTION

- A.** The Contractor's Corrosion Engineer shall submit their proposed test procedures to the Engineer at least five (5) days in advance of the time that the cathodic protection system testing is scheduled. The Owner or the Engineer shall witness all testing at their discretion. All test data shall be submitted to the Engineer within seven (7) days of the completion of the testing. All testing shall be conducted under the supervision of a qualified Corrosion Engineer who is retained by the Contractor. All deficiencies found to be due to faulty materials or workmanship shall be repaired or replaced by the Contractor and at no additional cost to the Owner.

B. Test Leads:

1. It is the Contractor's responsibility to test all test leads.
2. Test Method:
 - a. All completed wire connection welds shall be tested by striking the weld with a 2 pound hammer while pulling firmly on the wire. Welds failing this test shall be re-welded and re-tested. Wire welds shall be spot tested by the Engineer. After backfilling the pipe, all test lead pairs shall be tested using a standard ohmmeter.
3. Acceptance:
 - a. The resistance between each pair of test leads shall not exceed 150 percent of the total wire resistance as determined from published wire data.

C. Completion of the Work:

1. General:
 - a. The work shall not be considered complete until the installation is inspected and accepted by the Owner. The inspection shall consist of a visual examination and measurements for compliance with the Drawings and these Specifications. Any material or work found not to be in compliance with the Drawings or Specifications shall be repaired or replaced by the Contractor at no cost to the Owner. The work shall not be complete until it is approved in accordance with the provisions of these Specifications.

D. Cathodic Protection Performance Testing (Reservoir):

1. All performance testing shall be done by the Owner or Engineer. The Engineer shall be notified when all cathodic protection facilities have been installed. The Contractor must also coordinate the installation and the initial testing of the cathodic protection system with the Owner when the CP system is activated.
 2. After the Contractor has completed the installation of the cathodic protection system, the system shall be tested, to assure conformance with the specifications. Testing shall include a check for, proper installation of the cables, anodes, reference electrode and test station. Tank-to water potentials shall be obtained, and anode current output shall be measured in order to satisfy the relevant NACE criterion. Commissioning procedures and criterion of protection shall be in accordance with NACE Standard SP0169 and TM0497. Upon completion of the tests, a detailed written report shall be submitted describing any deficiencies detected. Any and all deficiencies shall be corrected by the Contractor at his or her cost and retested prior to final acceptance. All retesting shall be at the Contractor's expense.
 3. After the initial cathodic protection system performance testing has been completed, the Contractor shall disconnect the anode header cable inside of the anode control box such that the anodes and cathodic protection system are deactivated.
- E. The cathodic protection system shall remain de-activated for the entire coating warranty period. After the coating warranty inspection and necessary coating repairs, under the supervision and direction of the Corrosion Engineer and Owner the anodes shall be re-connected and the cathodic protection system, tested, and shall be adjusted (through the anode control box circuit) to comply with the protected levels described in NACE SP019.

3.08 COMPLIANCE WITH SPECIFICATIONS

- A. Deficiencies or omissions in materials or workmanship found by these tests and inspections shall be rectified at the Contractor's expense. Deficiencies shall include but are not limited to:
1. Broken leads;
 2. Improper or unclean trenches;
 3. Lack of 18-inch or slack wire in test boxes;
 4. Improperly mounted test boxes;
 5. Improper anode installations;
 6. Improper test box installations (including concrete pads around the test box); and
 7. Other deficiencies associated with the workmanship, installation, and non-functioning equipment.

3.09 CLEAN UP

- A. All debris, tools and storage materials shall be removed from the tank roof and from the premises when the work is complete. Anode port caps shall be installed. Any cost incurred by the Owner to clean up debris or materials resulting from this work shall be back charged to the Contractor.



PART 1 GENERAL

1.01 DESCRIPTION

- A. This section covers the contract items to supply and install the welded steel Water Tank including erecting, fixtures, appurtenances, painting, testing, cleaning, and disinfecting the tank.
- B. Tank shall be all-welded steel plate construction with column supported roof and cambered tank bottom as shown in the Drawings and specified herein.
- C. All items specified herein shall meet NSF 61 requirements where the product is used on potable water.

1.02 REFERENCES

- A. The following publications form a part of this specification to the extent referenced.
 - 1. American Institute of Steel Construction (AISC):
 - a. AISC Manual of Steel Construction, 15th Ed.
 - 2. American Petroleum Institute (API):
 - a. API 650 Welded Steel Tanks for Oil Storage, 13th Edition.
 - 3. American Society for Testing and Materials (ASTM):
 - a. ASTM A36 Standard Specification for Carbon Structural Steel.
 - b. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.
 - d. ASTM A320 Standard Specification for Alloy-Steel and Stainless-Steel Bolting for Low-Temperature Service.
 - e. ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - f. ASTM A992 Standard Specification for Structural Steel Shapes.
 - g. ASTM C33 Standard Specification for Concrete Aggregates.
 - h. ASTM C40 Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
 - i. ASTM D1557 Standard Test Method for Laboratory Compacting Characteristics of Soil Using Modified Effort.

- j. ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - k. ASTM F3125 Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 Mpa) Minimum Tensile Strength, Inch and Metric Dimensions.
4. American Welding Society (AWS):
- a. AWS A5.1 Standard Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
 - b. AWS D1.1 Structural Welding Code.
5. American Water Works Association (AWWA):
- a. AWWA D100-11 Welded Carbon Steel Tanks for Water Storage.
 - b. AWWA D102-21 Coating Steel Water-Storage Tanks.
 - c. AWWA C200-17 Steel Water Pipe, 6 in. and Larger.
 - d. AWWA C206-23 Field Welding of Steel Water Pipe.
 - e. AWWA C213-22 Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
 - f. AWWA C652-19 Disinfection of Water-Storage Facilities.
 - g. AWWA M42 Steel Water Storage Tanks – Revised (2013).
6. California Building Code (CBC), 2023.
- a. NSF/ANSI 61 – Drinking Water System Components – Health Effects.
 - b. OSHA Standard 1910.27 Occupational Safety and Health Administration – Scaffolds and Rope Descent Systems.
 - c. OSHA Standard 1917.118 Occupational Safety and Health Administration – Fixed Ladders.
7. Standard Specifications for Public Works Construction (SSPWC):
- a. Standard Specifications for Public Works Construction.
 - b. Standard Plans for Public Works Construction.

1.03 SUBMITTALS

- A. Shop drawings shall be submitted in accordance with Division 1 and as specified herein.
- B. Complete shop and erection drawings with dimensions, sizes, and thickness of plates and members; details of welded joints; fabrication and erection of steel work; including all accessories.
- C. The shop drawings shall show concrete foundation thickness and width, number and size of reinforcement, construction and erection details of all accessories and related work, and all other pertinent data concerning the construction of the tank foundation.
- D. Horizontal and vertical loadings, erection and settlement tolerances, and maximum loads imparted to the foundation and estimated weight of tank.
- E. Structural calculations of the water storage tank and accessory items prepared and sealed by a California Registered Civil or Structural Engineer. The name and address of the responsible Engineer shall appear on the cover of the submitted calculations. The submittal shall include a description of structural design, loading conditions, seismic anchorage calculations and details, and codes used in establishing the allowable stresses and safety factors.
- F. Site and Soil Analysis – The Contractor shall provide a statement that they have reviewed the Project Geotechnical Investigation Report.
- G. Certified mill tests on steel plate and structural members demonstrating compliance with specified ASTM standard.
- H. Complete manufacturer's data on shop prime coatings in accordance with the Technical Specification sections titled **“Protective Coating”** and **“Steel Tank Interior and Exterior Coating.”**
- I. Prior to the start of any construction, submit Welding Procedure Specification (WPS), Procedure Qualification Records (PQR), and welder, welding operator, and tack welder qualification test records for all shop and field welding in accordance with paragraph 8.2.1 and 8.2.2.1 of AWWA D100.
- J. Written report upon conclusion of field welding and testing concerning quality of field welding and in accordance with Section 11.2 of AWWA D100.
- K. Certified Radiograph Evaluation Report in accordance with Section 11.2 of AWWA D100.
- L. Operation and Maintenance Manual
 - 1. The Contractor shall submit for each valve a detailed operation and maintenance manual in accordance with the Supplementary General Conditions, General Conditions, and Division 1.

1.04 QUALITY ASSURANCE

- A. All materials, equipment, and installation methods shall be in accordance with AWWA D100 Welded Carbon Steel Tanks for Water Storage.

1. Inspection and Testing (refer to Section 11 of AWWA D100).
 2. Disinfection (refer to AWWA C652).
 3. Painting (refer to AWWA D102).
- B. Erection Contractor Qualifications
1. All Work in connection with erection of the tanks shall be performed by a competent and experienced erection contractor which has at least ten years' experience and whose record of experience and quality of Work are satisfactory to the Engineer. The erection contractor must have previously constructed a minimum of three steel water storage tanks of a similar size or larger.
- C. Design Responsibility
1. The Contractor shall provide certification, sealed by a California Registered Civil or Structural Engineer, stating that all members, elements, and connections of the tank are designed to withstand required loads and forces. Certification shall list the codes and specifications to which structural design conforms. Tank construction drawings, noted under Submittals of these specifications, shall bear the stamp of a California Registered Civil or Structural Engineer.
- D. Welding
1. Welding terms are as defined in AWS Standard Welding Terms and Their Definitions. Procedure specifications, procedure qualification tests, and welder's performance tests shall be in accordance with latest provisions of either AWS Standard Qualification Procedure or Section IX Welding Qualifications, ASME Boiler and Pressure Vessel Code.
 2. Requalification tests shall be required for welders that have not been using required welding procedures during previous six-month period.
 3. Protection shall be provided against radiation from arc where arc-welding operations might be viewed within harmful range by persons other than actual welders and welding operators.
 4. Items of equipment for welding and oxygen cutting shall be so designed, manufactured and in such condition as to enable qualified welders and welding operators to follow procedures and attain results specified.
- E. Warranty Inspection
1. First-Anniversary inspection requirements and failure criteria shall be in accordance with AWWA D102, Section 5, except as modified herein.
 2. A First-Anniversary warranty inspection will be conducted by the City, approximately eleven (11) months from the date of recording the Substantial Completion. The City shall establish the date of the inspection and will notify the Contractor at least thirty (30) calendar days in advance of the inspection. The tank will be drained by the City for the inspection. The City reserves the right to have tank warranty inspection and repairs completed while the tank is in service in a manner acceptable to the City.
 3. The Contractor shall furnish ventilation, scaffolding, and lighting equipment as necessary for warranty inspections, and shall be present for such inspections.

4. Inspection Report
 - a. The City will prepare and deliver to the Contractor a report of the warranty inspection, prior to the expiration of the 12-month warranty period. The inspection report will set forth the number and types of failures observed, the percentage of surface area where failures have occurred, and the names of the persons making the inspections. Photographs or reports of the coating imperfections or failures shall be considered acceptable evidence of failure.
5. Failure
 - a. Any location where coating has delaminated, peeled, blistered, or cracked; and any location where rusting is evident will be considered a failure of the coating system, unless, in the opinion of the City, the location in question is inaccessible per AWWA D102, Section 5.2.3.
6. Remedial Work
 - a. Repair all failures by removing the deteriorated coating, cleaning the surface, and recoating with the same system in accordance with this Section. With the approval of the City, surface preparation of small failures (areas less than 1 sq/ft) may be made by cleaning to bare metal in accordance with appropriate SSPC-SP standards.
7. Schedule of Remedial Work
 - a. The City shall establish a starting date and reasonable time of completion for the remedial work. The starting date shall be no more than thirty (30) calendar days after the submittal of the inspection report to the Contractor. Should the Contractor fail to start the remedial work within ten (10) calendar days after the starting date established by the City, the City may at its option perform the remedial work, and the Contractor shall pay to the City the actual cost of such work, plus 20 percent to cover added engineering and administrative cost.

PART 2 MATERIALS

2.01 TANK RINGWALL FOUNDATION

- A. Unless specified otherwise, the Contractor shall design and construct the tank foundation ringwall which meets the requirements of these specifications, and as shown on the Drawings, and the requirements of the soils and geologist reports. The tank ringwall foundation shall be a minimum of 3-feet in width by a minimum of 3-feet in depth and shall extend a minimum of 24-inches below finished grade. The steel water tank shell shall have an edge distance of 15-inches measured from inside face of the ringwall foundation as shown on the Drawings.
- B. The concrete ringwall shall be fitted with crack control joints at 15-feet on centers. A 1/2-inch-thick cane-fiber joint filler pad shall be placed between the ringwall foundation and tank bottom surface.
- C. A 12-inch-thick compacted layer of asphalt impregnated cushion, or structural fill material, compacted to a minimum of 95 percent compaction as determined by ASTM Test Designation D

1557 shall be placed under tank within the confines of the ringwall. A sample of the material shall be submitted for approval ten (10) days prior to the delivery date.

D. Corrosion Allowance and Steel Thickness

1. Provide corrosion allowance of 1/16-inch added to all steel plates and shapes in contact with water to surfaces below the overflow level.
2. Provide shell and bottom plates not less than 5/16-inch-thick, which includes corrosion allowance.
3. Where required per tank supplier design, provide additional thickness above specified minimum steel thicknesses for earthquake or wind loads.
4. Foundation subgrade preparation shall be in accordance with Technical Specification **“Excavation, Backfill, and Compaction.”**

2.02 MATERIALS OF CONSTRUCTION

- A. Unless otherwise described tank and interior appurtenances such as interior ladder and pipe shall be coated steel. Exterior appurtenances such as exterior ladder and handrails shall be galvanized steel.
- B. All tank hardware shall be stainless steel, ASTM A320, type 316.
- C. Tank plate shall be of hot rolled steel conforming to ASTM A36 and supporting framework shall be ASTM A992, all free of scale, pitting, or other surface defects.
- D. Nonstructural steel bars, angles, clips, and similar items shall comply with ASTM A36.
- E. Steel bolts shall comply with ASTM A307, Grade B.
- F. High strength steel bolts shall comply with ASTM A325.
- G. Steel assemblies and welding shall meet the requirements of Section 8 of AWWA D100.
- H. Steel water pipe 6-inches and larger in diameter shall comply with AWWA C213 and be fusion bonded epoxy lined in accordance with the Technical Specification section titled **“Protective Coating.”** Flanges shall conform to AWWA C207. Field welding shall be in accordance with AWWA C206.
- I. Metal surfaces shall be prime coated in accordance with the Technical Specification section titled **“Protective Coating.”** All materials employed on interior metal surfaces shall be listed as “accepted” for lining potable water tanks by the California City of Health Services.
- J. Prior to erection of tank, all steel surfaces made inaccessible after erection (except underside of bottom plates) shall be cleaned as specified herein and shall receive the coating/paint system for the specific area. This includes, but is not limited to, metal to metal contact areas, e.g., bolted joints, tops of roof rafters, and inaccessible areas, e.g., interior of overflow pipe, and interior/exterior of drainpipe.
- K. After erection of tank, the roof plates located over roof rafters shall be lifted and the area made inaccessible after the roof plates are resting on the rafters shall be cleaned as specified herein

and shall receive the coating/paint system for the tank interior, unless in the opinion of the Engineer, the area in question is still inaccessible after lifting.

- L. A tank bearing pad shall be installed on the concrete foundation ring as shown on the Drawings. The pad shall consist of 1/2-inch-thick cane-fiber joint filler per ASTM D1751 or approved equal.

2.03 ROOF

- A. The water storage tank roof shall be of the conical type and internal support beams and column as shown on the Drawings. Roof plates shall be a minimum of 3/16-inch thick. Roof support column shall be tubular and hermetically sealed and shall be provided with a base bearing plate.
- B. Roof plate lap joints on the tank interior shall be seal welded for entire length of joint. Lift roof plates over roof rafters as required to complete seal welding. Also, roof plate to knuckle joint shall be seal welded on the tank interior. Column base plate shall be seal-welded to the bottom plate.
- C. Design live load for the roof shall be at least 25 psf with no reduction factor allowed. Roof and its supporting members (rafters, girders, and columns) are also required to be designed for the vertical acceleration force due to an earthquake. The magnitude of vertical acceleration shall be determined from Section 2.01.C.1.e above. Supporting columns shall also be designed for the hydrodynamic forces due to an earthquake.
- D. The minimum lateral wave load to a column shall be computed per Section 2.02.C.1.b.1 above.

2.04 SHELL

- A. Shell plates shall be cold rolled to the tank radius. Top tees shall be rolled to the tank radius, and joints shall be butt welded. If structural bracing of the shell is required, these members shall only be placed on the inside of the shell. Shell plates shall include all vertical plates and the plates used to form the curved knuckle section at the top of the shell.

2.05 BOTTOM

- A. The water storage tank bottom shall be assembled by the lap joint method of construction as specified in Section 8 of AWWA D100.

2.06 ACCESSORIES

- A. General
 - 1. All Tank accessories shall be provided as indicated on the Drawings, conforming to AWWA D100.
- B. Shell Manholes
 - 1. Two circular, 30 inches diameter, shell manholes conforming to the requirements of Section 7.4 of AWWA D100, with hinge supported, outward opening, flanged covers shall be provided in the side wall of the tank. The manhole shall provide a watertight seal. A 3/4-inch 40 durometer neoprene gasket shall be provided to seal the cover. All fasteners shall be hot-dipped galvanized.
- C. Pipe Connections

1. Pipe connections shall conform to the requirements of Section 7.2 of AWWA D100, located as indicated. Reinforcing plates shall be sized to overlap bottom plates by minimum of 6- inches.

D. Tank Inlet-Outlet

1. Tank inlet-outlet shall be as shown on the Drawings; it shall be designed to prevent tank shell rupturing during seismic movement of the tank shell.
2. The Tank inlet and Tank outlet require connection to flexible expansion joint suitable for direct bury and provide a minimum 4-inch expansion.
3. Tank inlet-outlet connections shall be fully restrained.
 - a. Flexible expansion joints shall be installed in the locations indicated on the drawings and shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53. Foundry certification of material shall be readily available upon request.
 - b. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 350 PSI for 3 inch through 16-inch and 250 PSI for 18-inch and greater. 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: 20 degrees for sizes 4-inch through 12-inch; 15 degrees for sizes 14-inch through 36-inch and 12 degrees for size 48-inch. 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 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. Polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be included for direct buried applications.
 - g. Manufacturer's certification of compliance to the above standards and requirements shall be readily available upon request. The purchaser (or owner) shall reserve the right to inspect the manufacturer's facility for compliance.
 - h. All flexible expansion joints shall be The Force Balanced FLEX-TEND as manufactured by EBAA Iron, Inc. Eastland, TX., U.S.A, or approved equal.

E. Threaded Couplings Penetrations

1. Threaded couplings shall be welded in the tank wall as shown on the Drawings.
2. Provide nylon insulating bushing or insulated union, as directed by the Engineer, for dissimilar metals in accordance with Technical Specification **“Water Pipe and Fittings.”**

F. Overflow

1. The overflow shall conform to Section 7.3 of AWWA D100 and be as indicated on the Drawings. The overflow pipe shall be rigidly attached to the tank and be constructed with butt-welded joints. The overflow shall provide for continuous overflow of at least 2,300 gpm.

G. Exterior Tank Ladder

1. Each tank shall have an approved shell ladder extending a minimum of 12-inches above the top of the foundation to 4- inches above the ladder platform. The ladder runners shall not be less than 3/8 inches by 2-1/2-inches with spacing between side rails not less than 18-inches. The rungs shall not be less than one-inch slip-resistant round bars, spaced 12-inches apart on centers. The exterior ladder shall be hot-dipped galvanized after fabrication.
2. An OSHA mandated metal safety cage and a vandal deterrent shall be installed on the shell ladder with the low end of the vandal deterrent 2-inches above the bottom rung of the shell ladder. Additional 3/8-inch steel plates shall be welded to the ladder braces adjacent to the vandal deterrent, so as to fill the area between the ladder side rails and the structure for the length of the ladder gate. All intersections between these plates and the ladder side rails, ladder brackets, and the tank structure shall be seal welded. The vandal deterrent shall be hot-dipped galvanized after fabrication. The vandal deterrent shall be equipped with a hasp for a padlock. The Contractor shall lock the vandal deterrent at the completion of the Work, using a padlock furnished by the City. Manufactured ladder vandal deterrent shall be installed in accordance with manufacturer's instructions and recommendations.

H. Interior Tank Ladder

1. An approved interior ladder shall extend from the bottom of the tank to the roof hatch as shown on the Drawings. The ladder shall be mounted to the tank wall directly below the roof hatch.
2. The side rails shall not be less than 18 inches apart and the rungs shall not be less than 12 inches apart on centers.
3. The interior ladder shall be constructed of ASTM A276, type 316 stainless steel. The tank manufacturer shall design ladder top and bottom connections and intermediate supports. Rung connections to ladder rail shall be seal welded to fill voids.

I. Ladder Safe-Climbing Devices

1. Approved safe-climbing devices shall be rigid rail devices that meet OSHA Regulation 1910.27 and CAL-OSHA. Devices shall be installed in accordance with manufacturer's instructions and recommendations.
 - a. The acceptable safe-climbing device is:

- 1) SAF-T-CLIMB fall Prevention System, Notched Rail as manufactured by North Safety Products, or UC Safety Systems.

b. Main Components

- 1) Saf-T-Lok sleeve, the Saf-T belt and harness, and the Saf-T notch carrier rail.

- c. Requirements: The safe-climbing device rail shall deflect less than 1/8-inch when subjected to the weight of a 250-pound person leaning back on the ladder, supported only by the device and the rail.

d. Fasteners

- 1) All mounting hardware shall be of the material recommended and supplied by the manufacturer of the safe-climbing device. Any fasteners damaged during the installation of the device shall be replaced by the Contractor at no cost to the City.

e. Belts, Sleeves, and Lanyards

- 1) One belt and trolley or sleeve shall be furnished. Also, to be furnished is one 6 ft. long lanyards with a snap hook with a 1¼-inch to 1½-inch wide opening on one end and a snap hook to attach to the belt on the other.

f. Locations of Safe-Climbing Devices

- 1) Interior Ladder - A new tubular ASTM A 276 316 stainless steel safe-climbing device shall be installed from 30-inches above the bottom to the top of the interior ladder and equipped with a removable segment extending 42-inches above the roof.
- 2) Exterior Ladder - A new tubular galvanized steel safe-climbing device shall be installed from 30-inches above the ground to the top of the ladder and extending 48-inches above the roof.

g. Temporary Ladder Safety Devices

- 1) The Contractor shall be responsible for providing adequate temporary safety devices during construction prior to installation of the safe-climbing device on the ladder.

J. Roof Hatch

1. A 3-foot square hinged roof hatch shall be provided directly over the interior ladder.
2. The opening shall have a curb with a minimum height of 6-inches. The hatch shall have a downward overlap of at least two inches. The hatch shall be watertight and shall not allow any runoff into the water storage tank interior. The hatch cover shall be provided with a stainless-steel hasp for locking with a heavy-duty padlock and provisions to lock in the open position. The hatch shall be supplied with stainless steel hardware.
3. The roof hatch shall be located as shown on the Drawings.

4. The City will provide a padlock and keys.
- K. Bumped Head Vent
1. A 48-inch-diameter vent of the bumped head type conforming to AWWA D100 shall be provided. The vent shall be screened with stainless insect screen and stainless steel 6 x 6 x 20 gage mesh. The vent shall have the capacity to pass air so that excessive pressure is not developed at a flow either into or out of the tank of 5,000 gpm. The overflow pipe shall not be considered a tank vent.
- L. Name Plate
1. Provide manufacturer's standard name plate welded to tank shell.
- M. Vortex Breaker
1. Furnish and install manufacturer's standard vortex breaker on tank outlet.
- N. Ladder Platform Handrails
1. The platform shall have 42-inch-high handrails with one mid-rail, and safety chains across the opening at the exterior ladder. Handrails shall be standard 1-1/2-inch-diameter schedule 40 steel pipe handrail and posts conforming to ASTM A 53 and meeting the current OSHA requirements.
 2. Coat handrail with same system as the tank exterior.
- O. Tank Roof Perimeter Handrail
1. The tank roof shall have a 42-inch-high perimeter handrail with one mid-rail as shown on the Drawings. Handrails shall be standard 1-1/2-inch-diameter schedule 40 steel pipe handrail and posts conforming to ASTM A 53 and meeting the current OSHA requirements.
 2. Coat handrail with same system as the tank exterior.
- P. Water Level Indicator
1. Tank water level indicator shall be of aluminum and as shown on the Drawings.
 2. Coat steel with same system as the tank interior/exterior. Provide approved isolation between dissimilar materials.

2.07 CATHODIC PROTECTION

- A. Cathodic protection shall be installed in the tank interior in accordance with Technical Specification section titled "**Cathodic Protection System.**"

2.08 TREATED SAND LAYER

- A. A 12-inch treated sand layer shall be provided beneath the entire area of the tank. The treated sand shall consist of a mixture of sand and asphalt emulsion, 5 to 7 percent SC-70 liquid asphalt by weight. Submit mixture details for approval.

- B. The treated sand shall be prepared at a central mixing plant and delivered to the site for spreading and compacting. The resultant treated sand mixture shall be uniformly coated but not drip or show running with excess oil.
- C. Sand shall be free of organic material, trash, peat, and objectionable material and shall have a minimum sand equivalent value of 30 and 100 percent passing the No. 4 sieve. Sand shall be clean, sound, sharp, screened, and well-graded sand conforming to ASTM C 33 and additional requirements that aggregate with not less than 15 percent nor more than 30 percent, by weight, passing No. 50 sieve.
- D. No sand containing more than two percent of silt or which shows color darker than Plate 2 when tested according to ASTM C 40 shall be used. Resistivity before adding oil shall be greater than 3,000 ohm per cm when saturated with distilled water.
- E. Weighted average loss shall not exceed ten percent when sand is subjected to five cycles of soundness test using magnesium sulfate.

PART 3 EXECUTION

3.01 GENERAL

- A. Steel tanks shall be erected and tested in accordance with AWWA D100.
- B. Tank Foundation
 - 1. The tank shall be constructed on a reinforced concrete ringwall foundation as shown on the Drawings and specified herein. For construction, see the Technical Specification sections titled “**Excavation, Backfill, and Compaction**” and “**Concrete.**” All piping crossing beneath the tank floor and under the concrete ring wall foundation shall be encased in concrete as shown on the Drawings.
- C. Sand Cushion
 - 1. The Contractor shall furnish and place a treated sand layer cushion under entire tank area as indicated. The sand cushion shall be compacted using vibratory compactors immediately prior to placing bottom plates.
- D. Bearing Pad and Perimeter Seal
 - 1. Where the bottom plates bear on the concrete ring wall foundation, on any concrete encasement, or concrete foundations for columns, the bottom plates shall be supported on an 18-inch by 1/2-inch minimum thickness cane-fiber joint filler bearing pad.
 - 2. Extend bearing pad from inner edge of concrete ring wall foundation to outer steel edge of water storage tank.
 - 3. Trim any projections beyond outer edge of water storage tank to neat line flush with edge of bottom. Seal edge by caulking with polyurethane sealant per the Technical Specification titled “**Sealants and Caulking**” after completion of tank erection.

3.02 WELDING

- A. Butt welds shall be used for all joints (each side) in shell plates and shall have complete penetration and fusion with parent metal. Manual butt-welded joints in plates greater than 5/16-inch thick with beveled plate edges shall be in accordance with weld procedure specification for the specific joint in accordance with AWWA D100.
- B. Top joints for all roof plates shall be lap welded with full fillet weld for entire length of joint. Bottom joints between roof plates shall be seal welded for entire length of joint, unless in the opinion of the Engineer, the location in question is inaccessible for welding.
- C. Welds shall be as called for on accepted fabrication drawings and accepted procedure specification. Location or size shall not be changed without approval of the Engineer.
- D. No welding shall be allowed when surfaces are wet or when air temperature is lower than 20 degrees F unless abutting edges of plates being welded are carefully preheated to temperature warm to hand within radius of one foot of weld.
- E. All moisture present at point of welding shall be driven off by heat before welding commences. Where required by the approved weld procedure, wind breaks shall be provided for protection of welding operations.
- F. All welds, including tack welds in final welds shall be made by certified welders. Tack welds shall be cleaned and thoroughly fused with final weld. Defective, cracked, or broken tack welds shall be removed before final welding. Tack welds shall be removed from joints where stress is primary, if welding is to be manual. Depressions, undercuts, or gouges in base metal or weld metal caused by removal of staging clips, lugs, and braces shall be filled-in with sound weld metal and ground to smooth surface even with plate or weld.
- G. Each welder's identification mark shall be placed with crayon or paint (or stamping) near welds made. All weldments shall be properly associated with each welder.
- H. All weld metal shall be sound throughout, without cracks in any weld or weld pass. All welds shall be free from overlap, and base weld shall be free from undercutting. All craters shall be filled to full cross section of welds.
- I. The Contractor shall box, and seal weld any areas or surfaces difficult or inaccessible for future cleaning and painting by brush, rollers, or spray methods.
- J. Welded joints in contact with stored water and exterior welded joints exposed to rain or rain runoff shall be seal welded.

3.03 FIELD QUALITY CONTROL

- A. Qualification of Welders
 - 1. The Contractor shall certify the welders and welding operators in accordance with Section 8 of AWWA D100 and shall submit proof of such certification to the Engineer. Records of welders shall also be kept in accordance with Section 8 of AWWA D100.
- B. Weld Testing

1. Steel tank shall be inspected and tested in accordance with provisions of AWWA D100. All inspections and testing shall be completed under direct observation of the Engineer and, as they require, by inspectors representing the City.
2. Inspection of field welding shall be performed in accordance with the applicable provisions of AWWA D100, Section 11. The Contractor shall be responsible for inspecting and ensuring the quality of field welding. Weld quality shall be determined by spot radiographs or test segments, or both, of the number and location set forth in Section 11 of the AWWA D100 Specifications and as required herein by this specification.
3. If welding is unsatisfactory or indicates inferior workmanship, the Contractor shall correct all inferior welding and inferior workmanship and retest at no additional cost to the City.
4. At the conclusion of field welding, the Contractor shall submit a written report from a qualified, registered professional Engineer registered in California certifying that the field welding was inspected in accordance with the applicable portions of AWWA D100. The report shall include:
 - a. A statement of welder's credentials.
 - b. A summary of examination of radiographs and test segments.
 - c. Identification of unacceptable radiographs and test segments.
 - d. A summary of action taken to correct unsatisfactory welds.
5. The Contractor shall retain radiographs and test segments for at least three years, and shall, upon written request, make them available to the City for examination.
6. The City retains the right to hire an independent testing firm at any time at the City's sole discretion to monitor welding of the tank and to verify that the Contractor is erecting the tank in accordance with the specifications. If disagreement arises between evaluation report submitted by the Contractor's employed testing laboratory and independent testing firm, the Contractor may employ another independent laboratory, designated by the City, to make additional spot Radiographs. If additional Radiographic examinations indicate unsatisfactory welding, new tests shall be paid for by the Contractor.
7. As a minimum, radiographs shall be taken at the following locations:
 - a. At tank shell joints
 - 1) For welds of same type and thickness in structure, subject to primary stress, take one radiograph of first 10-feet of completed joint welded by each welder or welding operator.
 - 2) Thereafter, take one additional radiograph of welding from each additional 40 feet and any remaining major fraction. Include 30 percent of junction joints subject to primary stress and secondary stress with a minimum of eight such intersections.
 - b. 100 percent of repair welds.

8. Radiographs shall be examined and evaluated after approximately one-third, two-thirds, and at completion of welding on tank.
 - a. A minimum of 16-inches of weld length shall be provided for examination for each radiograph.
 - b. Two penetrometers shall be used for each film, placed at end of exposure adjacent and parallel to weld. Fluorescent type (so called calcium tungstate) screens are prohibited. Use lead screen type when using intensifying screens. Use fine-grained film or extra-fine grain film, coarse grain high-speed film is prohibited.
 - c. Provide a shell plate diagram showing radiograph locations.
- C. Vacuum Testing
 1. After tank bottom is completely welded and bottom ring attached, all welded seams in bottom shall be tested by using strong soap solution or linseed oil and a vacuum box.
 2. Repair and retest all seams that fail test until no leakage exists.
- D. Tank Filling and Leakage Testing
 1. Filling Operation
 - a. After completion of field fabrication, erection and coating, the tank shall be filled with water to check water tightness. The performance of the tank shall be monitored for faults before and during filling and testing, including settlement. Fault monitoring includes observation of leaks, distortions and taking levels at points marked on shell base plate around tank perimeter.
 - b. If the fault monitoring indicates danger of tank failure, the Contractor shall immediately cease filling operations and empty the tank. The Contractor shall have the tank manufacturer investigate the cause of the fault and report findings to the Engineer. The Engineer may also jointly investigate the cause of the fault with its own forces or engineering consultants. If the Engineer determines the fault is caused by the Contractor's failure to comply with the requirements of the Contract Documents, the Contractor shall correct the cause of the fault and repair the damage to the tank at no cost to the City. If the City determines the observed fault is not the responsibility of the Contractor, the City will negotiate the scope and cost of the repair with the Contractor.
 2. Tank Leakage Testing
 - a. Full water load maintained in tank for at least 48 hours during monitoring.
 - b. Leaks, which shall be defined as any noticeable moisture on the outside of the tank when the tank is full, shall be repaired by cutting out defective welds and re-welding and restoration of the coating system.

- c. No repair work shall be done until the tank can be drained and conditions are suitable for coating damaged surfaces. All repairs and re-tests shall be made at no additional cost to the City.

3. Water Supply

- a. For the initial test of water tightness for the new tank, water will be provided free of charge by the City. Should the tank fail the initial water tightness test, bacteriological tests or any other tests that would require draining of the tank, the Contractor shall pay the City for all water required for subsequent tests.

3.04 PAINTING

- A. Painting systems shall be applied in accordance with the requirements of AWWA D102 and the Technical Specification sections titled **“Protective Coating”** and **“Steel Tank Interior and Exterior Coating.”**
- B. The Contractor shall shop prime the tank. The Contractor shall bear all the expenses of verifying that the shop priming meets the intent of these specifications.
- C. Testing and final acceptance of completed tank painting shall be in accordance with the Technical Specification sections titled **“Protective Coating”** and **“Steel Tank Interior and Exterior Coating.”**
- D. Prior to erection of tank, all steel surfaces made inaccessible after erection (except underside of bottom plates) shall be cleaned as specified herein and shall receive the coating/paint system for the specific area. This includes, but is not limited to, metal to metal contact areas, e.g. bolted joints, tops of roof rafters, and inaccessible areas, e.g. interior of overflow pipe, stilling wells and interior/exterior of drainpipe.
- E. After erection of tank, the roof plates located over roof rafters shall be lifted and the area made inaccessible after the roof plates are resting on the rafters shall be cleaned as specified herein and shall receive the coating/paint system for the tank interior.

3.05 REPAIR OF DEFECTIVE GALVANIZED COATING

- A. Where zinc coating has been damaged after installation, substrate surface shall be first cleaned and then repaired with zinc dust-zinc oxide coating in accordance with ASTM A 780. Application shall be as recommended by the zinc dust-zinc oxide coating manufacturer. Coating shall consist of multiple coats to dry film thickness of eight mils.
- B. Items not physically damaged, but which have insufficient or deteriorating zinc coatings, and items damaged in shipment or prior to installation, shall be removed from the Project site for repair by the hot-dip zinc coating method.

3.06 CLEANUP

- A. Upon completion of all tank painting work, the Contractor shall remove all staging, scaffolding, containers, surplus materials, and rubbish from the premises in a manner approved by the Engineer and shall leave the premise in a clean and orderly condition. Spent sand from the blast operation may not be disbursed onsite.

- B. Prior to disinfecting, the complete interior shall be cleaned with an approved cleaner or detergent applied via high-pressure hot solution method. Immersed areas shall be scrubbed with a brush or similar implement, which will apply force and pressure to the surface to completely remove residual solvents and other surface contaminants.
- C. Cleaned surfaces shall then be rinsed with clean water. Residual water and contamination removed during washing process shall be thoroughly flushed from tank. The Contractor shall obtain approval of the Engineer prior to draining any residual water to waste. This operation shall be accomplished after completion of interior coating work as directed by the Engineer.
- D. Upon completion of the Work, the Contractor shall remove all staging, scaffolding, abrasives, containers, etc., from the Work site in a manner approved by the Engineer. Disposal of abrasive blast residue shall be in a manner consistent with guidelines set forth by the U.S. Environmental Protection Agency (USEPA) or California City of Public Health (CDPH).
- E. Materials classified as hazardous shall be removed and disposed of in a manner consistent with standards and guidelines set forth by the above-named agencies, or as directed by the Engineer.
- F. Coating, paint spots and/or oil stains upon adjacent surfaces shall be removed and the job site cleaned, repaired, or refinished to the satisfaction of the Engineer, at no cost to the City.

3.07 DISINFECTION

- A. In accordance with Technical Specification titled **“Disinfection of Water Mains, Pump Stations, and Reservoirs.”**
- B. Disinfection of interior surfaces shall be performed in the presence of the Engineer in accordance with all the requirements of applicable regulatory agencies. Disinfection shall be performed after protective coatings have been applied to the interior surfaces and successfully tested.
- C. The Contractor shall bear all costs of disinfection (and dichlorination if necessary) except that the City shall take the water samples for the disinfection testing.
- D. Disposal of all liquids drained from the tank shall be the responsibility of the Contractor and shall be performed in accordance with a plan that has been prepared and submitted by the Contractor to the Regional Water Quality Control Board for approval.
 - 1. No water that contains chlorine or VOC compounds shall be discharged without an approved plan.
 - 2. At a minimum the plan shall address the separation of solids from the water and the neutralization of chemicals to acceptable concentrations.
 - 3. The quantities of chemicals required to neutralize residual chlorine concentrations may be found in AWWA Section C651, Appendix “C” of the most recent edition of the AWWA Standards.
 - 4. No water containing chlorine shall be discharged to the water of the State.

3.08 ACCEPTANCE

- A. Acceptance by the City of the completed Work as herein specified is subject to a guarantee by the Contractor against any repairs, leaks or damage caused by defective workmanship or

materials furnished by the Contractor for a period of 1 (one) year after Notice of Acceptance has been issued.

1.01 GENERAL

1.02 DESCRIPTION

- A. This section covers the contract items Pipe Supports including materials and installation of pipe supports.

1.03 PIPE SUPPORTS INCLUDES:

- A. Pipe supports as shown in the Technical Specification section titled “**Structural Steel and Miscellaneous Metalwork.**”
- B. Concrete as shown in the Technical Specification section titled “**Concrete.**”
- C. Subgrade preparation as shown in the Technical Specification section titled “**Excavation, Backfill, and Compaction.**”
- D. The Contractor shall provide pipe supports, seismic restraints, hangers, guides, and anchors, complete, in accordance with the Contract Documents prepared by a California Professional Engineer licensed as a Civil Engineer or Structural Engineer.
- E. Provide materials, equipment and labor required to execute this Work as indicated on the Drawings, specified herein and necessary to complete the Work of this section.

1.04 REFERENCES

- A. The following publications form a part of this specification to the extent referenced:
1. American National Standards Institute (ANSI).
 2. American Society for Testing and Materials (ASTM):
 - a. ASTM A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 3. American Society of Mechanical Engineers (ASME):
 - a. ASME B31.1 Power Piping.
 4. American Water Works Association (AWWA).
 5. American Welding Society (AWA).
 6. California Plumbing Code (CPC), 2016.
 7. Standard Specifications for Public Works Construction (SSPWC):
 - a. Standard Specifications for Public Works Construction.
 - b. Standard Plans for Public Works Construction.

1.05 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled “**Submittals.**”

1. Shop Drawings: Shop drawings shall include the following information:
 - a. Drawings and calculations of pipe supports, restraints, hangers, anchors, and guides sealed by a California Professional Engineer (Civil or Structural).

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Code Compliance: Piping systems and pipe connections to equipment shall be properly anchored and supported to prevent undue deflection, vibration, dislocation due to seismic events and line pressures, and stresses on piping, equipment, and structures. Supports and parts thereof shall conform to the requirements of ASME B31.1 - Power Piping, except as supplemented or modified below. Supports for plumbing piping shall be in accordance with the latest edition of the applicable California Plumbing Code.
- B. Structural Members: Wherever possible, pipes shall be supported from structural members. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided at no additional cost to the City. All supplementary members shall be in accordance with the requirements of the building code and the American Institute of Steel Construction and shall be acceptable to the Engineer.
- C. Riser Supports: Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.
- D. Freestanding Piping: Free-standing pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to steel frames fabricated from angles, channels, or I-beams anchored to the structure. Exterior, free-standing overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps securing the pipes.
- E. Materials of Construction:
 1. General: Pipe support assemblies, including framing, hardware, and anchors, shall be steel construction, hot-dipped galvanized after fabrication, or Type 316 stainless steel construction based on specific location (below grade) and application (submerged) unless otherwise indicated on the construction Drawings.
 2. Submerged Supports: Submerged piping, as well as piping, conduits, and equipment in hydraulic structures within 24-inches of the water level, shall be supported with support assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel, unless otherwise indicated.

2.02 SUPPORT/ANCHOR SPACING

- A. Supports and anchors shall be as shown on the construction Drawings. Supports and anchors for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose concentrated loads. Pipe support spacing shall not exceed the maximum spans as shown. For temperatures other than ambient temperatures, or those shown, and for other piping materials or wall thicknesses, the pipe support spacing shall be

modified in accordance with the pipe manufacturer's recommendations. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of all loading effects.

2.03 MANUFACTURED SUPPORTS

- A. Stock Parts: Where not specifically indicated, designs that are generally accepted as exemplifying good engineering practice and use stock or production parts, shall be utilized wherever possible. Such parts shall be locally available, new, of best commercial quality, designed and rated for the intended purpose.
- B. Manufacturers:
 - 1. Eaton B-Line.
 - 2. Or equal.

2.04 COATING

- A. Galvanizing: Unless otherwise indicated, fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Pipe supports, seismic restraints, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and ASME B31.1 - Power Piping. Concrete inserts for pipe hangers and supports shall be coordinated with the form work.
- B. Appearance: Pipe supports and hangers shall be positioned to produce an orderly, neat piping system. Hanger rods shall be vertical, without offsets. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, without interference with other work.

3.02 FABRICATION

Quality Control: Pipe hangers, supports, and seismic restraints shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available. Fabricated supports shall be neat in appearance without sharp corners, burrs, and edges.



PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Detailed requirements for various ductile iron piping products for potable water. Some products specified in this section may not be required for this contract. Refer to the Drawings to determine particular ductile iron piping products to be provided under this contract.
2. This section does not include ductile iron piping used to convey storm water. Ductile Iron piping specifications for storm water shall be in accordance with the Technical Specifications "**Storm Drain and Fittings.**"

1.02 SUBMITTALS

A. Product data:

1. Manufacturer's specifications, catalog cuts, and literature:
 - a. Pipe.
 - b. Inside linings.
 - c. Mechanical and push-on joints.
 - d. Flanged joints.
 - e. Standard fittings.
 - f. Special fitting.
 - g. Wall pipe and floor pipe.

B. Submit outside coating system for buried, interior, exterior, and submerged piping locations.

C. Submit product data and coating system information specified above in one complete submittal.

D. Submit in accordance with the Technical Specification section titled "**Submittals.**"

E. Shop drawings showing layout for ductile iron piping systems shall be submitted in accordance with and transmitted under appropriate piping system specification section.

PART 2 PRODUCTS

2.01 PIPE

A. Materials: AWWA C151, ductile iron.

B. Minimum thickness class:

15012 - DUCTILE IRON PIPING

1. Mechanical and push-on joint pipe: Pressure Class 350, unless shown or specified otherwise.
2. Flanged joint pipe: Thickness Class 53.

2.02 JOINTS

A. Joint type:

1. Liquid and air services in buried locations shall be restrained push-on joint.
2. Liquid and air service in locations other than buried shall be flanged.
3. As shown on Drawings or as specified in system specification if different than specified above for services and locations.

B. Mechanical and push joints:

1. AWWA C111.
2. Gasket material:
 - a. Suitable for service and maximum operating temperature of piping system as specified in piping system specification section.
 - b. Selected by pipe manufacturer.
3. Restrained joints:
 - a. Manufacturers:
 - 1) American Cast Iron Pipe Company, Flex-Ring and Lok-Ring.
 - 2) U.S. Pipe and Foundry Company, TR-Flex.
 - b. Provide restrained joints for all buried piping systems.
 - c. Mechanical locking type to provide positive restraint from joint separation without use of restraining rods, straps, clamps, setscrews, or retainer glands.
 - d. Minimum pressure rating: 250 psi.

C. Flanged joints:

1. Flanged pipe shall be in accordance with AWWA C115.
2. Fabrication of flanged pipe, including assembly of flange on pipe shall be performed by pipe manufacturer in accordance with AWWA C115. Assembly of flange on pipe outside of manufacturer's shop is unacceptable.
3. Flange material for flanged pipe shall be ductile iron. Flanged pipe with gray iron flanges is not acceptable.

15012 - DUCTILE IRON PIPING

4. Gasket material shall be suitable for service and maximum operating temperature of piping system as specified in piping system specification section. Torque requirement of gaskets shall be less than torque rating of flange, bolt, and nuts.
5. Gaskets shall be ring or full face, 1/8-inch-thick, and conform to dimensions shown in Appendices to AWWA C110 and AWWA C115.
6. Bolts:
 - a. Size, length, and number as shown in AWWA C110 and AWWA C115.
 - b. Material: Carbon steel, ASTM A307, Grade B.
 - c. Dimensions: ANSI B18.2.1, heavy hex.
7. Nuts:
 - a. Size, length, and number as shown in AWWA C110 and AWWA C115.
 - b. Material: Carbon steel, ASTM A307, Grade B.
 - c. Dimensions: ANSI B18.2.2, heavy hex.

2.03 FITTINGS

- A. Pressure rating shall be 250 psi, minimum.
- B. Standard fittings:
 1. Mechanical and push-on joint fittings:
 - a. Ductile iron.
 - b. AWWA C110 or AWWA C153.
 2. Flanged joint fittings:
 - a. Ductile iron.
 - b. AWWA C110.
 - c. Flange dimensions in accordance with AWWA C115.
- C. Special fittings, not included in AWWA standard, shall be manufacturer's standard, based on AWWA design principles, and in compliance with applicable requirements of AWWA standard.
- D. Wall pipe and floor pipe:
 1. Ductile iron.
 2. Wall thickness of body equal to or greater than wall thickness of connecting pipe.
 3. Flanges set flush with face of concrete shall be tapped for stud bolts.

4. Collar dimensions as shown on the Drawings.
 5. Collar cast integral with pipe or fabricated by welded attachment of collar to pipe.
 6. Fabricated wall pipe and floor pipe shall be as follows:
 - a. Rated for dead and thrust due to 250 psi internal pressure.
 - b. Ductile iron collar welded continuously around pipe on both sides of collar.
 - c. Weld in pipe manufacturer's shop by qualified welder.
 - d. Electrodes: AWS A5.15, Class ENiFe-CI or AWS 5.6, Class ECuAl-2.
 - e. Manufacturer: American Cast Iron Pipe Company, or equal.
- E. Miscellaneous fittings:
1. Provide miscellaneous fittings, such as cutting in sleeves, tapping sleeves, caps, plugs, and other fittings, as required for complete system.
 2. Manufacturer of miscellaneous fittings shall be same manufacturer as pipe.
 3. Miscellaneous fittings shall be suitable for service.

2.04 INSIDE LINING

- A. Pipe and fittings shall be cement lined.
- B. Cement lining shall be in accordance with AWWA C104/ANSI A21.4.

2.05 OUTSIDE COATING

- A. Provide buried piping with asphaltic coating in accordance with applicable AWWA 110/ANSI A 21.10 and AWWA C151/ANSI A 21.51.
- B. Surface preparation, priming, and finish coating of non-buried piping shall be compatible and in accordance with proposed finish topcoat. Ductile iron pipe shall be shop primed with the coating specified in Technical Specification section titled "**Protective Coatings.**"
- C. Finish color for interior and exterior piping shall be selected by the City. The intermediate and finish coating is specified in Technical Specification section titled "**Protective Coatings.**"
- D. Coating for piping embedded in concrete is not required.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install and support pipe in accordance with standard practices.
- B. Buried piping: In accordance with the Technical Specification section titled "**Excavation, Backfill and Compaction.**"

3.02 JOINT ASSEMBLY

- A. Push-on and mechanical joint in accordance with manufacturer's written instructions.
- B. Flanged joint in accordance with piping system specification section, flanged pipe manufacturer's written instructions, and gasket manufacturer's written instructions.

3.03 WALL PIPE

- A. Support by formwork to prevent contact with reinforcing steel.

3.04 TAPPING

- A. Taps for cement-lined and unlined pipe shall be in accordance with pipe manufacturer's instructions.
- B. Provide service saddles for tap sizes greater than 1-inch. Service saddles are not required for tap sizes 1-inch and smaller.



PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Process mechanical manual, air and electrically actuated valves.
2. Valve Accessories: Positioners, position indicating transmitters, hand switches, position switches and other accessories.
3. Some products specified in this section may not be required for this Contract. Refer to Drawings and Specifications to determine particular products to be provided under this Contract.
4. This section does not include the flow control valve. The flow control valve shall be furnished and installed in accordance with Technical Specification titled "**Hydraulically Operated, Diaphragm Activated Valve.**"

1.02 SUBMITTALS

A. Submit in accordance with the Technical Specification section titled "**Submittals.**"

B. Shop Drawings:

1. Provide manufacturer's standard product data and catalog information for valves, actuators, and accessories.
2. Provide dimensional drawings of each different size and type of valve and actuator assembly showing actuator mounted on valve and valve or actuator mounted accessories.
 - a. Show maintenance and component replacement clearances required.
3. Submit schedule in tabular form that lists for each valve: Pressure rating, torque required at valves rated differential pressure, actuator torque rating, actuator type, valve size, manufacturer's valve and actuator product number, and accessories provided.
4. Identify valves by valve equipment number. Factory torque sheets minimally supplying actuator output and valve input torque requirements. Method for calculating input torque shall be the same as per AWWA Class 150B designation.

C. Operation and Maintenance (O&M) data in accordance with Technical Specification section titled "**Start Up and Commissioning.**"

1.03 QUALITY ASSURANCE

A. Provide valves, with same valve type number, from single manufacturer as much as practical to achieve standardization for operation, maintenance, spare parts, and manufacturer's services.

B. Provide actuators, with same actuator type number, from one manufacturer to achieve standardization for operation, maintenance, spare parts, and manufacturer's services.

15030 - VALVES AND APPURTENANCES

- C. Cast name of valve manufacturer and size of valve on body or bonnet or show on permanently attached plate in raised letters.
- D. Cast on valve body or indicate on actuator word "open" and arrow indicating direction to open.
- E. Valve and actuator manufacturers shall have 5 years minimum experience in all technologies and devices used in design of product.

PART 2 PRODUCTS

2.01 GENERAL

- A. All materials and lubricants shall be NSF 61 certified for potable water applications.

2.02 BALL VALVES

- A. Type BV-1: Use for general air and water services.
 - 1. Manufacturers:
 - a. Conbraco, Apollo 77-100 Series.
 - b. Engineer approved equal.
 - 2. 2-1/2-inch and smaller.
 - 3. Full bore ports.
 - 4. Bronze, with Teflon seats.
 - 5. Screwed ends.
 - 6. Hand lever actuator.
 - 7. Rated 600 psig WOG, 150 psi SWP.
 - 8. Blow-out-proof stem design.
- B. Type BV-2: Use where ball valves shown on PVC piping systems.
 - 1. Manufacturers:
 - a. Spears 2000 Industrial.
 - b. Asahi Duo Bloc True Union.
 - c. Nibco True Bloc True Union.
 - d. Engineer approved equal.
 - 2. 1/2-inch through 3-inch.
 - 3. Double union design, with two-way blocking capability.
 - 4. ASTM D1784, Type 1, Grade 1 PVC body, ball, stem, union nuts, and end connectors.
 - 5. Teflon seats.

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6. Viton or teflon O-ring seals as recommended by valve manufacturer for service conditions.
7. Solvent weld socket ends.
8. Hand lever actuator.
9. Rated 150 psi at 120°F. Suitable for vacuum service.

2.03 GATE VALVES, 2-INCHES TO 12-INCHES

- A. Gate valves shall be Resilient Seated Gate Valves conforming to AWWA C509 or AWWA C515. Valves shall be rated for a minimum working pressure of 150 psi and shall have end fittings to conform to the pipe or fittings being connected. Valves shall be provided with operating nuts when installed underground, and handwheels when installed aboveground.
- B. Valves shall be American Flow Control "Series 2500", Mueller "2360 Series", Clow "Model 2639/2640", or approved equal.

2.04 CHECK VALVES

2.05 Check Valves above Ground

1. Manufacturers:
 - a. GA Industries, Inc., Figure 220.
 - b. Engineer approved equal.
2. 2-1/2-inch through 12-inch.
3. Swing check with outside lever and weight.
4. Cast iron body and trim with stainless steel hinge shafts, cast iron disc.
5. Flanged ends meeting 125 pounds ANSI standards.
6. Rated 200 pounds WOG.
7. Stainless steel body seat, resilient field replaceable seat ring on disc.

2.06 ACCESSORIES

1. Valve Actuator
 - a. Open valve by turning counterclockwise.
 - b. Provide actuator type as specified under each valve section above, unless otherwise shown or specified.
 - c. For valves, 3-inch and larger, provide chain wheel actuator if centerline of valve handwheel or lever operator is 5-feet. 6-inches or greater above operating floor. Provide chain wheel actuator for other sizes of valves if noted on Drawings or specified.

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- 1) Provide chain wheel actuated valves with enclosed worm and gear operators.
- d. Provide valves with chain lever actuator if shown on Drawings.
- e. Buried and submerged valve actuators:
 - 1) Provide seals on shafts and gaskets on valve and actuator covers to prevent water entry.
 - 2) Provide totally enclosed actuator mounting brackets with gasket seals.
2. Chain wheels and chain levers:
 - a. Provide chain wheels with guides and chain having proof coil design.
 - b. Provide chain levers with chain having proof coil design.
 - c. Galvanize or cadmium plate chain wheels, chain levers, guides, and chain.
 - d. Chain size as recommended by valve manufacturer.
 - e. Extend chains to within 4-feet of operating floor.
 - f. Provide chain hooks and tieback anchors for chains. Install so chain does not interfere with personnel traffic.
3. Worm and gear actuators:
 - a. Totally enclosed design.
 - b. Sized for valve operation under valve rated pressure with pull of 40 lbs. on handwheel or chain wheel.
 - c. Self-locking to prevent valve position creep.
 - d. Hardened alloy steel worm.
 - e. Reduction gearing runs in lubricant.
 - f. Orientate operators to avoid interference with adjacent piping, equipment, and structures.
 - g. Valve position indication.
4. Valve boxes, pipe extension and extension stems.
 - a. Valve boxes shall be provided for all gate valves placed underground and shall be similar and equal to Brooks Products, Inc., No. 3-RT or Christy G5, with 8-inch SDR 35 PVC pipe extension sleeve; cover to be marked "Water."

- b. Extension stems shall be solid 1-1/4-inch round or square Type 316 stainless steel bar with a circular centering guide and shall be complete with 2-inch square operating nut. No pinned couplings are permitted.

2.07 COATING

- A. Valves and service saddles shall be fusion-bonded epoxy lined and coated at the manufacturer and finish coated in the field in accordance with Technical Specification section titled “**Protective Coating**”. Shop surface preparation, shop priming, and field coating shall be as per the coating manufacturer’s recommendations.

2.08 TRACER WIRE

- A. Tracer wire shall be in accordance with the Technical Specification titled “**Facility Identification.**”

2.09 POLYETHYLENE ENCASEMENT

- A. Polyethylene encasement shall be in accordance with the Technical Specification titled “**Water Pipe and Fittings.**”

2.10 FLANGE INSULATION KITS

- A. Flange insulation kits shall be in accordance with the Technical Specification titled “**Water Pipe and Fittings.**”

2.11 BOLTS, NUTS, AND WASHERS FOR FLANGES

- A. Flange hardware shall be in accordance with the Technical Specification titled “**Water Pipe and Fittings.**”

2.12 GASKETS

- A. Gaskets for flanged joints shall be in accordance with the Technical Specification titled “**Water Pipe and Fittings.**”

PART 3 EXECUTION

3.01 GENERAL

- A. Installation practices shall conform to manufacturer's recommendations and as shown on the Drawings.
- B. Before installation, carefully clean valves of all foreign material, and inspect valves in open and closed positions. Install valves in accordance with the applicable portions of these Specifications. Unless otherwise indicated, install valves with the stem vertical. Mount horizontal valves so that adequate clearance is provided for operation.
- C. Prior to installing flanged valves, the flange faces shall be thoroughly cleaned. After cleaning, insert the gasket and tighten the nuts progressively and uniformly. If flanges leak under pressure, loosen the nuts, reseal, or replace the gasket, re tighten the nuts, and retest the joint.

- D. Thoroughly clean threads of screwed joints by wire brushing, swabbing, or other approved method. Apply approved joint compound to threads prior to making joint. Joints shall be watertight at test pressures before acceptance.
- E. Valves shall be pressure tested at the same time that the connecting pipelines are pressure tested. See the Technical Specification titled “**Water Pipe and Fittings**” for pressure testing requirements.

3.02 VALVE BOXES, PIPE EXTENSIONS, AND EXTENSION STEMS

- A. Installation of valve boxes, pipe extensions, and extension stems shall conform to the contract drawings.
- B. Valve boxes shall be firmly supported and shall be kept centered and plumb over the operating nut of the valve.
- C. Beveled sections of pipe shall not be allowed at the top of the valve riser pipe. The top cut shall be square and machine made.

3.03 TRACER WIRE

- A. Tracer wire for valves and water services shall installed be in accordance with the Technical Specification titled “**Facility Identification.**”

3.04 POLYETHYLENE ENCASEMENT

- A. Polyethylene encasement for buried valves and couplings shall be installed in accordance with the Technical Specification titled “**Water Pipe and Fittings.**”

3.05 FLANGE INSULATION KITS

- A. Flange insulation kits for buried and above grade pipe shall be installed in accordance with the Technical Specification titled “**Water Pipe and Fittings.**”

3.06 BOLTS, NUTS, AND WASHERS FOR FLANGES

- A. Hardware shall be installed in accordance with the Technical Specification titled “**Water Pipe and Fittings.**”

3.07 GASKETS

- A. Gaskets for flanged joints shall be installed in accordance with the Technical Specification titled “**Water Pipe and Fittings.**”

3.08 TESTING

- A. Valves shall be tested for leakage at the same time that the connecting pipelines are hydrostatically tested. See the Technical Specification titled “**Water Pipe and Fittings**” for pressure testing requirements. Joints shall show no visible leakage under test. Repair joints that show signs of leakage prior to final acceptance.
- B. Meter services shall not be hydrostatically pressure tested during the testing of pipeline in accordance with the Technical Specification titled “**Water Pipe and Fittings.**”

1. Water services shall be tested up to the curb stop only.

3.09 EXAMINATION

A. Tests:

1. Factory or shop test each actuator.
2. At minimum, tests shall include: demonstration that unit capable of supplying required torque, current at maximum torque setting, flash test, torque at maximum torque setting and output speed or operating time.

B. Test Certificate:

1. Provide test certificate for each actuator.
2. Test Certificate Requirements:
 - a. Indicate test results and test date.
 - b. Serial and model number.
 - c. Gear ratios.
 - d. Closing direction.
 - e. Wiring diagram number.
 - f. Motor data.

3.10 FIELD QUALITY CONTROL

A. Pressure Tests:

1. Pressure test valves at same time adjacent piping is tested.
2. Repair leaking joints.
3. Protect parts of valves or actuators that could be damaged by test.

B. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at job site or classroom designated by Owner for minimum days indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include minimum of:
 - a. 1/2 day for Instructional Services for each different actuator type.
2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting.



PART 1 GENERAL

1.01 DESCRIPTION

- A. This section covers the contract item Disinfection and describes the requirements for disinfection of potable water mains, booster pump stations, water storage tank, appurtenances, and connections by chlorination, in accordance with AWWA, and as specified herein.

1.02 REFERENCES

- A. The following publications form a part of this Specification to the extent referenced.

1. American Water Works Association (AWWA):
 - a. AWWA B300 Hypochlorites.
 - b. AWWA B301 Liquid Chlorine.
 - c. AWWA C651 Disinfecting Water Mains.
 - d. AWWA C652 Disinfection of Water Storage Facilities.
 - e. AWWA C653 Disinfection of Water Treatment Plants.
 - f. AWWA C654 Disinfection of Wells.
2. City of Orland – Standard Plans and Specifications.

1.03 SUBMITTALS

- A. Submittals shall be furnished in accordance with the Technical Specification section titled **“Submittals.”**
- B. Submit a comprehensive flushing and disinfection plan covering all items to be disinfected (pipelines, pump stations, system connections, water storage tank).
- C. The rate of flow and locations of discharges shall be scheduled in advance to permit review and coordination with the Owner and cognizant regulatory authorities.
1. Potable water shall be used for chlorination.
- D. Requests for use of water from City waterlines shall be submitted to the Owner 48 hours in advance.
- E. Bacteriological Report:
1. Date issued, project name, and testing laboratory name, address, and telephone number.
 2. Time and date of water sample collection.
 3. Name of person collecting samples.

4. Test locations.
 5. For community water system or well, initial, and 24-hour disinfectant residuals in ppm for each outlet tested.
 6. For individual water system or well, initial, and 3-hour disinfectant residuals in ppm for each outlet tested.
 7. Coliform bacteria test results for each outlet tested.
 8. Certify water conforms, or fails to conform, to bacterial standards of Environmental Protection Agency.
- F. Certification of Disinfection. Approval and acceptance by the Owner is a condition of final payment.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with AWWA C651, AWWA C652, AWWA C653, and AWWA C654 as applicable.
- B. Chlorination Company:
1. All testing shall be performed by independent testing companies with a Class A license, and/or who are certified to perform the required pressure testing and disinfection. Testing companies will be required to provide the Engineer with certified testing results. The testing company shall provide gauges and meters which have been calibrated and certified at least quarterly.

PART 2 PRODUCTS

2.01 LIQUID CHLORINE SOLUTION

- A. Liquid chlorine solution shall be in accordance with the requirements of ANSI/AWWA B301, and shall be injected with a solution feed chlorinator, a water booster pump, or a sufficiently pressurized source of water to provide an adequate flow to inject and disperse the chlorine solution.

2.02 CALCIUM HYPOCHLORITE (DRY)

- A. Calcium Hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300 and shall be dissolved in water to a known concentration in a container and pumped into the pipeline at a measured rate.

2.03 SODIUM HYPOCHLORITE (SOLUTION)

- A. Sodium Hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300 and be diluted in water to desired concentration and pumped into the pipeline at a measured rate.

2.04 CALCIUM HYPOCHLORITE TABLETS AND ADHESIVE

- A. Chlorine Content:
1. The tablets shall have an average weight of 5 grams each and shall contain not less than 70 percent of available chlorine.

- B. Adhesive:
 - 1. Adhesive shall be a type that will not impart taste, odor, or detrimental compounds to the water supply.
- C. Storage:
 - 1. Proper care shall be taken to store hypo-chlorite tablets in tightly closed containers where they will not be accessible to children or unauthorized persons.

2.05 CHLORINE RESIDUAL TEST KIT

- A. For measuring chlorine concentration, a medium range, drop count, titration kit or an orthotolidine indicator comparator with wide range color discs shall be used. The kit shall be capable of determining chlorine concentration in the range 1.0 to 25 mg/L.
- B. Test kits shall be Hach Chemical, Hellige, or equal.
- C. An adequate number of kits shall be maintained by the Contractor in good working order and available for immediate test of residuals at points of sampling.

PART 3 EXECUTION

3.01 GENERAL

- A. All chlorination and flushing activities shall be in accordance with AWWA C651, C652, C653, C654, and SSPWC Section 306-8.9.4.3.
- B. Chlorinate all fittings, valves, plugs, etc. before connecting to the Owner's water system. This procedure must be observed by a designated City representative prior to the start of all connection related work.
- C. The Contractor is hereby notified that the contamination of the Owner's water supply due to negligence on the Contractor's part will result in the Engineer's and the Owner's costs being deducted from the contract. Examples of such costs include the Engineer's and Owner's expense to correct the contamination problem and address all notification related procedures.
- D. Prior to flushing, meet with the Engineer's and the Owner's staff to review the Contractor's flushing plan.
- E. The Engineer and Owner reserve the right to change and/or modify the plan based upon the area's ability to contain the discharge.

3.02 EXAMINATION

- A. Examine the areas and conditions under which Work of this section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.03 PIPELINES

- A. General:

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1. Before being placed into service, all pipelines and appurtenances shall be chlorinated.
 2. Accomplish sterilization of completed water mains and service laterals, in accordance with AWWA C651-14 titled, "Disinfecting Water Mains," shall be used as a guide in performing this operation where applicable.
 3. Flushing, disinfection, sampling, and dechlorination shall be made in the presence of the Owner. The Contractor shall notify the Owner at least seventy-two (72) hours prior to Flushing and disinfection activities.
 4. Potable water shall be used for chlorination.
- B. Flushing Completed Lines
1. Before the main is chlorinated, it shall be filled to eliminate air pockets and flushed to remove particulates. The flushing velocity in the main shall not be less than 2.5 feet per second. Flushing is not a substitute for lack of preventive measures during construction. Flushing of completed lines prior to chlorination shall be accomplished as thoroughly as possible with the water pressure and outlets available. The flushing shall be done after the successful pressure tests have been made.
 2. Flush pipes for a minimum of the time period calculated from the formula: $T = 2/3L$, in which:
 - a. T = flushing time, in seconds.
 - b. L = pipe length, in feet.
 3. Refer to Paragraph 3.07, Disposal of Chlorinated Water for other requirements.
- C. Chlorination of Completed Lines
1. Before being placed in service, the entire pipeline installation (mains, laterals, blowoffs, valves, air valves, and water services) shall be chlorinated. Chlorine shall be applied by one of the following methods: liquid chlorine; sodium or calcium hypochlorite water solution; or chlorine tablets. The chlorinating agent shall be applied at a point not more than ten feet downstream from the beginning of the new main. Water shall be fed slowly into the new main with chlorine fed at a constant rate such that the water will have not less than 25 mg/L free chlorine. The application of chlorine shall conform to AWWA C651-14 and shall be injected through a corporation cock or other connection ensuring treatment of the entire line. Portions of the existing mains which have been connected to a new line or otherwise contaminated by construction shall be included in the system sterilized. A residual of not less than 10 parts per million after 24 hours shall be produced in all parts of the line. During the chlorination process, all valves shall be operated.
 2. Water Services
 - a. Every service connection served by a main being disinfected shall be tightly shutoff at the curb stop before water is applied to the main. Care shall be taken to expel all air from the main and services during the filling operation.
 - b. Water services shall be disinfected up to the curb stop.

3. Tie-ins
 - a. At water tie-ins, minimum disinfection shall be achieved by swabbing the new pipe sections and fittings with a 5% hypochlorite solution before installation and flushing the main from both directions, if possible, before returning the system to service.

D. Water Quality Samples and Testing

1. The Owner will take necessary samples and submit them for testing. The initial tests will be paid for by the Owner. If initial tests fail, the Owner will obtain additional samples and submit for testing at the Contractor's expense. When all tests have been passed, the pipe and fittings shall be sufficiently flushed to cleanse the pipe and fittings of the disinfecting agent. Connections to the Owner's existing water system will only be made when the Owner is satisfied that the Contractor has met the requirements of AWWA C651-14.
2. The Contractor shall coordinate required sampling with the Engineer and the City.
3. The Contractor shall provide adequate and convenient means for the Owner to collect an appropriate number of water samples for each segment of pipeline tested.

E. Repetition of Procedure

1. If the initial chlorination fails to produce required residuals and bacteriologic results, chlorination and testing shall be repeated until satisfactory results are obtained at no additional cost to the Owner.

F. Final Flushing

1. After chlorination, the water shall be flushed from the lines at the extremities until the replacement water tests are equal, chemically, and bacteriologically, to those of the permanent water supply.

3.04 PUMP STATIONS

A. General:

1. Accomplish sterilization of completed booster pump station, in accordance with AWWA C651-14 titled, "Disinfecting Water Mains," shall be used as a guide in performing this operation where applicable and as specified herein.
2. The booster pump, barrel, piping, and discharge head piping shall be disinfected as a complete unit. Adequate bracing shall be provided to resist thrust.

B. Depth of Disinfection:

1. The well shall be disinfected to its full depth. A double capped, perforated pipe container filled with granular chlorine compound shall be moved up and down the entire water-filled casing and screen section until the entire chlorine compound has dissolved.

C. Pump Column Disinfection:

1. The pump column shall be washed with a chlorine solution, containing at least 12 percent chlorine, as the pump column is lowered into the pump can.

D. Mixing:

1. After the well or booster pump has been placed into position, it shall be turned on and off several times so as to thoroughly mix the disinfectant with the water in the pump can. The pump shall be run until the water discharged has the odor of chlorine. This procedure shall be repeated several times at one-hour intervals.

E. Disinfection Time:

1. After mixing, the pump shall be allowed to stand without pumping for 24 hours.

F. Flushing:

1. Water shall be pumped to waste until the presence of chlorine is no longer detectable, as determined by testing for available chlorine residual using a test kit by the Contractor's approved testing company. Allow the pump to stand without pumping for 24 hours. Refer to Paragraph 3.06, Disposal of Chlorinated Water for other requirements.

G. Bacteriological Tests:

1. The Owner will take necessary samples and submit them for testing. The initial tests will be paid for by the Owner. If initial tests fail, the Owner will obtain additional samples and submit for testing at the Contractor's expense. When all tests have been passed, the pump station pipe and fittings shall be sufficiently flushed to cleanse the pump station pipe and fittings of the disinfecting agent. Connections to the Owner's existing water system will only be made when the Owner is satisfied that the Contractor has met the requirements of AWWA C651-14.
2. All coliform test results must be negative and heterotrophic plate counts must be less than 500 colonies/mL prior to placing the well or booster pump into service.

H. Repetition of Procedure:

1. If the laboratory analysis shows the water is not free of bacterial contamination, the disinfection procedure shall be repeated. Depending on the level of contamination, it may be necessary to use a higher concentration chlorine solution. The water shall then be re-tested at no additional cost to the Owner. Two consecutive samples must pass the bacteriological tests before the pump can be placed in service.

3.05 RESERVOIRS

A. General:

1. Accomplish sterilization of completed water tank, in accordance with AWWA C652-19 titled, "Disinfection of Water Storage Facilities," and as specified herein.
2. The Contractor shall make all necessary provisions for conveying water from the Owner's designated supply source to the points of use.

B. Facilities to be Disinfected:

1. All hydraulic structures and appurtenant pressure piping shall be tested; those for potable water shall also be disinfected. In the case of a reservoir, testing and disinfecting

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operations shall be combined. Disinfection shall be accomplished by chlorination. All chlorinating and testing operations shall be done in the presence of the Engineer.

C. Scheduling:

1. Disinfection operations shall be scheduled by the Contractor as late as possible during the contract time period so as to assure the maximum degree of sterility of the facilities at the time the Work is accepted by the Owner.

D. Bacteriological Testing:

1. The Owner will take necessary samples and submit them for testing. The initial tests will be paid for by the Owner. If initial tests fail, the Owner will obtain additional samples and submit for testing at the Contractor's expense.
2. Samples shall be tested by the Owner's selected laboratory for coliform bacteria and heterotrophic plate count.
3. Results of the bacteriological testing shall be satisfactory to the Owner or other appropriate regulatory agency. Passing tests on two consecutive days for heterotrophic plate count (<500 cfu/mL) and absence from coliform bacteria must be achieved prior to placing the reservoir into service.

E. Release of Disinfection Water:

1. Release of water from structures, after testing and disinfecting have been completed, shall be acceptable to the Owner.

F. Preliminary Cleaning and Flushing:

1. Prior to both testing and disinfecting, all hydraulic structures shall be cleaned by thoroughly hosing down all surfaces with a high-pressure hose and nozzle of sufficient size to deliver a minimum flow of 50 gpm. All water, dirt, and foreign material accumulated in this cleaning operation shall be discharged from the structure or otherwise removed.

G. Disinfection of Hydraulic Structures and Appurtenant Pipelines:

1. All hydraulic structures which store or convey potable water shall be disinfected by chlorination. Chlorination of hydraulic structures shall be performed in accordance with the requirements of ANSI/AWWA C-652.
2. Chlorination:
 - a. A strong chlorine solution (about 200 mg/L) shall be sprayed on all interior surfaces of the structure. Following this, the structure shall be partially filled with water to a depth of approximately one foot. During the partial filling operation, a chlorine-water mixture shall be injected by means of a solution feed chlorinating device in such a way as to give a uniform chlorine concentration during the entire filling operation. The point of application shall be such that the chlorine solution will mix readily with the in-flowing water.

- b. The dosage applied to the water shall be sufficient to provide a chlorine residual of at least 50 mg/L upon completion of the partial filling operation. Precaution shall be taken to prevent the strong chlorine solution from flowing back into the lines supplying the water. After the partial filling has been completed, sufficient water shall be drained from the lower ends of appurtenant piping to ensure filling the lines with the heavily chlorinated water.
- 3. Retention Period:
 - a. Chlorinated water shall be retained in the partially filled structure and appurtenant piping long enough to destroy all non-spore forming bacteria, and in any event, for at least 24-hours. After the chlorine treated water has been retained for the required time, the free chlorine residual in the structure and appurtenant piping shall be at least 25 mg/L. All valves shall be operated while the lines are filled with the heavily chlorinated water.
- 4. Final Filling of Structure:
 - a. After the free chlorine residual has been checked, and has been found to satisfy the above requirement, the water level in the structure shall be raised to its final elevation by addition of potable water.
 - b. Before final filling is commenced, the concentration of heavily-chlorinated water remaining in the structure and piping shall, unless otherwise acceptable to the Engineer, be sufficient to produce a free chlorine residual of between 1 and 2 mg/L when the water level is raised to its final elevation. After the structures have been filled, the strength of the chlorinated water shall be determined. If the free chlorine residual is less than 1 mg/L, an additional dosage shall be applied to the water in the structure. If the free chlorine residual is greater than 2 mg/L, the structure shall be partially emptied and additional potable water added. In no case shall water be released prior to the expiration of the required retention period.
 - c. Refer to Paragraph 3.06, Disposal of Chlorinated Water for other requirements.

3.06 DISPOSAL OF CHLORINATED WATER

- A. Legally dispose of chlorinated water.
- B. Dechlorination Prior to Disposal:
 - 1. Following chlorination and prior to discharge, the water shall be dechlorinated such that a residual of not more than 0.02 parts per million (instantaneous maximum) of chlorine is present in any water discharged.
 - 2. Dechlorinated water shall be discharged into the nearest storm drain system.
- C. At the approval of the Owner, the Contractor may dispose of chlorinated water through select storm drain piping.

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnish and installation of the Hydraulically operated, diaphragm activated valve.

1.02 REFERENCES

A. The following publications form a part of this specification to the extent referenced.

1. NSF International (NSF)
 - a. NSF 61: Drinking Water System Components – Health Effects
 - b. All valves provided in this Specification to be NSF 61 rated
2. ASTM International (ASTM)
 - a. ASTM A536 Standard Specification for Ductile Iron Castings

1.03 SUBMITTALS

A. Submit in accordance with the Technical Specification section titled **“Submittals.”**

B. Shop Drawings:

1. Flow control schematics specifically edited for each valve along with all accessories and sizes.

PART 2 PRODUCTS

2.01 COMBINATION RATE OF FLOW CONTROLLER AND SOLENOID SHUT-OFF VALVE

A. Manufacturers:

1. Cla-Val.
2. Or Approved Equal.

B. Description:

1. Capable of maintaining flow rate of 700 gallons per minute (gpm).
2. Only allows flow in one direction:
 - a. Pilot system to include feature that restricts flow from reversing direction.
3. The valve shall automatically throttle and limit flow to a preset maximum rate, regardless of changing line pressure, by sensing the differential across an appropriately sized orifice plate. Flow rate is adjustable by changing the pilot set point. When differential pressure

across the orifice plate is less than the pilot set-point the rate of valve opens allowing flow to meet the pre-determined demand. If differential pressure across the orifice plate exceeds the pilot set point, the rate of flow valve closes, limiting the flow to a preset maximum. The solenoid control shall intercept the rate of flow control and allow for remote override capability to close the main valve. Clean or replace internal diaphragm if deemed necessary by manufacturer.

C. Materials:

1. Valve Body: 8-inch
 - a. Body & Cover: Ductile Iron-ASTM A536.
 - b. Main Valve Trim: Stainless Steel.
 - c. Seat: Stainless Steel.
 - d. Stem, Nut and Spring: Stainless Steel.
 - e. Seal Disc: Buna-N Rubber.
 - f. Diaphragm: Nylon Reinforced Buna-N Rubber.
 - g. Internal Trim Parts: Stainless Steel.
 - h. End Detail: Flanged (8-inches).
 - i. Pressure Rating: Class 150 pounds.
 - j. Temperature Range: Water to 180°F.
2. Pilot Control System:
 - a. Body & Cover: Stainless Steel.
 - b. Pilot Trim: Stainless Steel.
 - c. Rubber: Buna-N.
 - d. Connections: National Pipe Thread (NPT/FNPT).
 - e. Pressure Rating: 400 psi Max.
 - f. Temperature Rating: Water to 180°F Max.
3. Solenoid Pilot Control:
 - a. Body: Stainless Steel.
 - b. Pilot Trim: Stainless Steel.

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- c. Seals and Disc: NBR.
 - d. Core and Plugnut: Stainless Steel.
 - e. Core Springs: Stainless Steel.
 - f. Shading Coil: Copper.
 - g. Disc-Holder: CA.
 - h. Core Guide: CA.
 - i. Connections: FNPT.
 - j. Pressure Rating: 400 psi Max.
 - k. Temperature Rating: AC: Water to 125°F Max, DC: Water to 104°F Max.
 - l. Power Supply: 120VAC / 60 Hz.
 - m. Solenoid Enclosure: NEMA Type 1.
4. Auxiliary Diaphragm Valves:
- a. Body and Cover: Stainless Steel.
 - b. Trim: Brass & Stainless Steel.
 - c. Rubber: Buna-N.
 - d. Connections: FNPT.
 - e. Pressure Rating: 400 psi Max.
 - f. Temperature Rating: Water to 180°F Max.
5. Pilot Control Tubing: Stainless Steel
6. Pilot Control Fittings: Stainless Steel
7. Orifice Plate Assembly:
- a. Plate Holder: Ductile Iron-ASTM A536.
 - b. Orifice Plate: Stainless Steel 302.
 - c. Sensing Connections: FNPT.
- D. Assembly (or) Fabrication
- 1. Main Valve

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- a. The main valve shall be hydraulically operated, single diaphragm actuated, globe pattern. 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 the operating pressure from line pressure. Packing glands, stuffing boxes and/or rolling diaphragm technology will not be permitted and there shall be no pistons operating the main valve or pilot controls. No fabrication or welding shall be used in the manufacturing process. Y-pattern valves shall not be permitted. Main valve shall comply with NSF/ANSI 61 and certified lead free to NSF/ANSI 372 as a safe drinking water system component.
 2. Main Valve End Connections
 - a. End Connections for control valve shall be flanged per ASME/ANSI B16.42, Class 150
 3. Main Valve Body
 - a. No separate chamber(s) below the diaphragm shall be allowed between the main valve cover and body. No fabrication or welding shall be used in the manufacturing process.
 4. Pilot Control System
 - a. The rate of flow pilot control shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve designed to close when the controlling differential exceeds the adjustable spring setting. The pilot control is normally held open by the force of the compression on the spring above the diaphragm and it closes when the pressure acting on the underside of the diaphragm exceeds the spring setting. The pilot control shall have a second downstream sensing port which can be utilized to install a pressure gauge. Pilot shall comply with NSF/ANSI 61 and certified lead free to NSF/ANSI 372 as a safe drinking water system component.
 - b. The solenoid shutoff pilot control shall be a direct acting three-way poppet solenoid valve controlled by an external electrical power source. Solenoid shall have a NEMA IV enclosure.
 - c. The pilot control system shall include a strainer, a fixed orifice closing speed and all required control accessories, equipment, control tubing and fittings. No variable orifices shall be permitted. Pilot to be manufactured by control valve manufacturer.
 - d. An orifice plate flange assembly shall be included and mounted one to five pipe diameters downstream of the rate of flow control valve. The Contractor shall connect the sensing line between the pilot system and the orifice plate assembly.
- E. Finishes:

1. Coatings for valves shall be as recommended by manufacturer. A final field coating shall be applied to match connected piping.

F. Accessories:

1. Nameplate:
 - a. Provide nameplate including but not limited to catalog number, function, size, material, pressure rating, end-connection details, type of pilot controls used, and control adjustment range.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's written instructions and approved submittals.

3.02 FIELD QUALITY CONTROL

A. Manufacturer's Field Service:

1. Provide manufacturer's representative to be present at the Site for a minimum of 1 Workday, travel time excluded, for assistance during installation, startup and adjustment, and training of Owner's personnel. Training shall take place after the system is fully operational and adjusted. The Contractor shall schedule with the Owner a minimum of 48 hours prior to the training at a time convenient with the Owner. Include minimum of:
 - a. 1/3 Day for Installation Services.
 - b. 1/3 Day for Instructional and Startup Services.
 - c. 1/3 Day for Post-Startup Services.
2. Ensure that manufacturer's representative takes and records upstream and downstream static and dynamic pressures. Pressure reducing valve shall be adjusted accordingly and as recommended by the Owner.



PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Pressure Gauges and Fittings:
 - a. Pressure gauges.
 - b. Pressure gauge isolation diaphragms.
 - c. Pressure gauge isolation valve.
- B. Meters and gauges furnished as part of factory-fabricated equipment may be specified as part of equipment assembly in other sections.

1.02 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled **“Submittals.”**
- B. Product Data:
1. Manufacturer's technical product data, including installation instructions, for each type meter and gauge. Include scale range, ratings, and calibrated performance curves, certified where indicated.
 2. Meter and gauge schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gauge.
 3. Indicate Tag Number for each gage proposed.

1.03 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of meters and gauges, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 yrs.
- B. Regulatory Requirements:
1. UL Compliance: Comply with applicable UL standards pertaining to meters and gauges.
 2. ANSI and ISA Compliance: Comply with applicable portions of ANSI and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gauges.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

- A. Manufacturers:
1. Ametek/U.S. Gauges.

2. Marsh Instrument Company, Unit of General Signal.
 3. Marshalltown Instruments, Inc.
 4. Trerice (H.O.) Company.
 5. Weiss Instruments, Inc.
 6. Or approved equal.
- B. Provide pressure gauges of materials, capacities, and ranges indicated, designed, and constructed for use in service indicated.
- C. Type: General use, 1 percent accuracy, ANSI B40.1 Grade A phosphor bronze bourbon type, bottom connection.
- D. Case: Drawn steel or brass, glass lens, 4-1/2-inch-diameter.
- E. Connector: Minimum 1/2-inch male NPT.
- F. Scale: White coated aluminum with permanently etched markings.
- G. Range:
1. Typical operating point shall be at mid-range.
 2. Scale shall begin at zero and pump shut-off head shall not exceed 90% of upper gauge range.
 3. Provide measurement units of psi and/or ft H₂O.

2.02 PRESSURE GAUGE ISOLATION DIAPHRAGM

- A. Manufacturers: Same as for pressure gauges.
- B. Provide pressure gauge isolation diaphragm between pressure gauges and process connection on chemical feed and wastewater piping systems.
- C. Materials: Teflon isolation diaphragm. 304 SS housing with clean out design.

2.03 ISOLATION VALVE

- A. Provide full port true union ball valve between process connection and isolation diaphragm.
- B. Verify compatibility of valve materials and process stream.
- C. Materials: 304 SS valve housing and connection nipples, unless as otherwise required due to process stream.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which meters and gauges are to be installed. Do not proceed with the Work until unsatisfactory conditions are corrected.

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- B. Select pump scale range specific for each application. Verify scale range with the Engineer.

3.02 INSTALLATION OF PRESSURE GAUGES

- A. Install pressure gauges in piping tee with pressure gauge cock, located on pipe at most readable position.
- B. Locations: Install in following locations and elsewhere as indicated:
 - 1. At suction and discharge of each pump provided.
- C. Pressure Gauge Cocks: Install in piping tee with snubber.
- D. Pressure Gauge Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

3.03 ADJUSTING

- A. Adjust faces of meters and gauges to proper angle for best visibility.

3.04 CLEANING

- A. Clean windows of meters and gauges and factory-finished surfaces. Replace cracked or broken windows, repair any scratched or marred surfaces with manufacturer's touch-up paint.



PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Couplings, flanged coupling adapters, and service saddles required for piping connections. Some products specified in this Section may not be required for this Contract. Refer to the piping system specification section(s) and the Drawings to determine particular products to be provided under this Contract.

1.02 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled “**Submittals.**”
- B. Submit manufacturer’s catalog data and detail construction sheets showing all parts, dimensions, linings, coatings, and describing materials of construction by material and specification (such as AISI, ASTM, SAE, or CDA).

PART 2 PRODUCTS

2.01 COUPLINGS

- A. Couplings for connecting plain-end steel or ductile iron pipe of same outside diameter:
1. Dresser Style 38.
 2. Smith-Blair Product No. 411.
- B. Transition couplings for connecting plain-end steel or ductile iron pipe of different outside diameter:
1. Dresser Style 162.
 2. Smith-Blair Product No. 413.
- C. Pressure rating shall be greater than test pressure of piping system.
- D. Materials:
1. Middle Ring and Gaskets: As selected by manufacturer. Suitable for fluid service and maximum operating temperature of piping system.
 2. Followers: Ductile iron or steel.
 3. Bolts and Nuts: Manufacturer's standard.

2.02 FLANGED COUPLING ADAPTERS

- A. Flanged coupling adapters for connecting plain-end steel or ductile iron pipe to flanged pipe, fitting, valve, instrument, or equipment item:
1. Dresser Style 128.

2. Smith-Blair Product No. 913.
- B. Pressure rating shall be greater than test pressure of piping system.
- C. Materials:
 1. Flange: Steel, faced and drilled to 150 pounds class in conformance with ANSI B16.5.
 2. Body: Steel.
 3. Follower: Ductile iron or steel.
 4. Gasket: As selected by manufacturer. Suitable for fluid service and maximum operating temperature of piping system.
- D. Bolts and Nuts: Manufacturer's standard.

2.03 SERVICE SADDLES

- A. Service saddles for tapping pipe sizes 18-inches and smaller shall be double strap design.
 1. Smith-Blair Product No. 317 or approved equal.
- B. Service saddles for tapping pipe sizes larger than 18-inches shall be triple strap design.
 1. Smith-Blair Product No. 366.
- C. Materials:
 1. Body: Malleable iron or ductile iron.
 2. Straps: Steel.
 3. Nuts and Washers: Manufacturer's standard.
 4. Gasket: As selected by manufacturer. Suitable for fluid service and maximum operating temperature of piping system.

2.04 FLEXIBLE COUPLE WITH RESTRAINT

- A. Plain End Pipe to Flanged Pipe
 1. Manufacturers:
 - a. Smith-Blair Product No. 912 with Studs.
 - b. Or Approved Equal.
 2. Materials:
 - a. Body and Flange: Ductile Iron per ASTM A-536.
 - b. Gasket: Nitrile NSF 61.
 - c. Bolts and Nuts: Carbon Steel per ASTM A307, Electro galvanized with a dichromate seal.

- d. Studs: Carbon Steel per ASTM A193, Electro galvanized with a di-chromate seal.
- e. Coating: Fusion bonded epoxy per AWWA C213.

B. Flanged Pipe to Flanged Pipe

1. Manufacturers:

- a. Smith-Blair Product No. 975.
- b. Or Approved Equal.

2. Materials:

- a. Body: Carbon Steel per ASTM A-53.
- b. Follower Flange: Ductile Iron per ASTM A536.
- c. Flange: Carbon Steel per AWWA C207 Class D.
- d. Gasket: Nitrile NSF 61.
- e. Tie Rods: Carbon Steel per ASTM A193.
- f. Spigot: Carbon Steel per ASTM A53.
- g. Coatings: Fusion bonded epoxy per AWWA C213.

2.05 ANCHORS

- A. Provide anchors including, but not limited to, tie rods, lugs, harness assemblies, flanged spool pieces, friction collars and hardware for each coupling, and flanged coupling adapter. Anchors shall restrain pipe to prevent movement out of each coupling and flanged coupling adapter.
- B. Design each anchor to sustain force developed by test pressure of piping system.
- C. Anchor studs placed perpendicular to longitudinal axis of pipe is unacceptable.
- D. Anchorage with welded attachments to ductile iron piping is unacceptable.

2.06 COATINGS

- A. Coatings for couplings, flanged coupling adapters, and service saddles shall be fusion-bonded epoxy lined and coated at the manufacturer and finish coated in the field in accordance with Technical Specification section titled “**Protective Coating.**” Shop surface preparation, shop priming, and field coating shall be as per the coating manufacturer’s recommendations.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.

PART 1 GENERAL

1.01 SCOPE

- A. This section describes materials and installation of potable water and storm drain facilities identification for pipe, valves, valve boxes, and other pipeline appurtenances.
- B. Specified herein is applicable to all piping below grade.

1.02 SUBMITTALS

- A. Submit in accordance with the Technical Specification section titled “**Submittals.**”
- B. Submit manufacturer catalog cutsheets and specifications for locator tape, tracer wire, terminal boxes, grounding rod, splice kits, attachment tape, and appurtenances.
- C. If required by the Engineer, submit material samples of locator tape.
- D. Submit proposed method of connecting to existing identification/locating systems.
- E. Submit locations of all tracer wire dead ends, proposed and as-built locations of all tracer wire access boxes, proposed locations of all spliced connections, tracer wire testing firm qualifications, tracer wire testing plan and procedures, and tracer wire continuity test results.

PART 2 MATERIALS

2.01 BURIED PIPING LOCATOR TAPE

- A. Buried Piping Locator Tape shall be solid aluminum foil core detectable tape and be installed for all potable water pipelines 1-inch and larger. The tape shall have a minimum thickness of 5 mil and be manufactured using a 0.8 mil clear virgin polypropylene film, reverse printed and laminated to a 0.35 mil solid aluminum foil core, and then laminated to a 3.75 mil clear virgin polyethylene film.
- B. Tape wording shall be:
 - 1. Potable Water Line - “CAUTION POTABLE LINE BURIED BELOW.” APWA Color Code: Blue.
 - 2. Storm Drain Line “CAUTION STORM DRAIN BURIED BELOW.” APWA Color Code: Green.
- C. The overall width of the tape and lettering size shall be in accordance with the following table.

<u>Pipe Size</u> (inches)	<u>Locator Tape Width</u> (inches)	<u>Min Lettering Size</u> (inches)
2 and less	2	1.5
Less than 8 and greater than 2	2	1.5
8 and larger	2	1.5

- A. Detectable locator tape shall be as manufactured by Pro-Line Safety Products Company, T. Christy Enterprises, or approved equal.

2.02 TRACER WIRE

- A. Tracer wire shall be direct bury type 10 AWG solid copper with High Molecular Weight Polyethylene (HMWPE) insulation (30 mil thickness minimum). The insulation shall be blue in color. Tape for securely attaching the tracer wire to the pipe shall be Polyken 900, or equal.
- B. The wire shall be electrically continuous throughout the entire piping system.
- C. Splices
 - 1. All buried mainline splices shall be 3M DBR direct bury watertight connectors or approved equal shall be used to provide electrical continuity.
 - 2. Branch connection (water services, fire hydrant laterals, blowoffs, etc.) tracer wire shall be a single tracer wire properly spliced to the main line tracer wire. DryConn Direct Bury Lug Aqua watertight connectors, or approved equal, shall be used to provide electrical continuity.
 - 3. If approved by the Owner, splices located within structures shall be 3M DBR direct bury watertight connectors or as shown on the Plans.
- D. If shown or required by the Engineer, grounding rods shall be Copperhead 1.5 pound drive-in magnesium anode or approved equal.
- E. Where tracer wire is not brought to the surface inside valve or meter boxes, at grade terminal boxes shall be traffic rated, constructed of a cast iron body with a blue high-strength resin two terminal switchable lid, and be equipped with an encapsulated magnet for easy detection. At grade terminal boxes shall be Copperhead SnakePit Roadway or approved equal.

PART 3 EXECUTION

3.01 PIPE LOCATOR TAPE

- A. Unless otherwise shown on the Drawings, locator tape shall be installed 12-inches above the pipe and shall be centered over all pipelines, including lines to fire hydrants, blowoffs, water services, and air valves.
- B. Tape shall be installed/buried flat without kinks or tears. The tape shall be installed continuously for the entire length of the pipe.

3.02 TRACER WIRE

- A. Unless otherwise shown on the Drawings, tracer wire shall be installed in conjunction with locator tape on all pipelines, including lines to fire hydrants, blowoffs, water services, gate valves, and air valves.
- B. Tracer wire shall be installed as shown on the Drawings.
- C. Tracer wire shall be installed with all pipelines, centered on and just above the top or crown of the pipe.

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- D. The wire shall be installed in such a manner as to be able to properly trace all pipelines, laterals, and services without loss or deterioration of signal or without the transmitted signal migrating off the tracer wire.
- E. The tracer wire shall be securely taped to the pipe every 8- to 10-feet, and on each side of a valve or fitting.
- F. At each valve, air valve, blind flange, water service, fire service, fire hydrant, blowoff, and connection to existing pipelines, the wire shall be brought up to the surface as shown on the Drawings.
- G. At fire hydrants, the tracer wire shall terminate by using Engineer approved means of connecting to an upper fire hydrant bolt at the break off riser.
- H. Except for approved splice connections, the tracer wire shall be continuous and without splices from each tracer wire access point. Where any approved spliced-in connections occur, when not located in a structure only direct bury watertight connectors as specified herein shall be used to provide electrical continuity. Splices located within structures shall be direct bury watertight connectors or as shown on the Plans.
- I. Spliced connections between the main line tracer wire and branch connection tracer (e.g. service lines) wire shall only be allowed at water main tees, crosses, or at iron or copper water services where a portion of the branch connection water main or water service is replaced with non-iron or non-copper material. The branch connection tracer wire shall be a single tracer wire properly spliced to the main line tracer wire. Where the existing branch connection is neither iron nor copper, then the new branch connection tracer wire shall be properly spliced to the existing tracer wire on the branch connection.
- J. At tees, the three wires shall be joined using a single 3-way lockable connector. At crosses, the four wires shall be joined using a 4-way connector.
- K. Protect wire insulation from damage during installation and backfilling. Wire insulation that is broken, cut, or damaged shall be replaced.
- L. Tracer wire on all water services shall terminate in the meter box.
- M. Tracer Wire Access Points
 - 1. Tracer wire access points shall in general be at every mainline valve box, air valve, fire hydrant, water service meter box, blowoff valve box, and other locations as shown. Concentrations of multiple proposed valves near pipe intersections, i.e. tees or crosses, may require more than one access point assembly in each valve box. Tracer wire access points shall be within the City or County right of way or within Owner acquired easements.
 - 2. Spacing between tracer wire access points shall be 1,500 feet or less. The Contractor shall provide and install access boxes at Engineer approved locations, as required to meet this requirement.
 - 3. Tracer wire access box

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- a. Specifically manufactured for this purpose, shall be approved by the Engineer.
 - b. All grade level/in-ground access boxes shall be appropriately identified with “water” cast into the cap and be APWA color coded.
 - c. All trace wire access boxes shall include a manually interruptible conductive/connective link between the terminal(s) for the trace wire connection and the terminal for the grounding anode wire connection.
 - d. Provide concrete collar per valve box detail shown.
- N. If shown or required by the Engineer, tracer wire shall be properly grounded at all dead ends and stubs. Grounding of tracer wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20-feet of copper wire connected to an anode (minimum weight of 1.5 pound) specifically manufactured for this purpose and buried at the same elevation as the utility.
- O. Where existing tracer wire is encountered on an existing utility that is being extended or tied into, the new and existing tracer wire shall be connected using an Engineer approved splice connector, shall be properly grounded at the splice location as specified, and shall be completely waterproof to prohibit corrosion and loss of conductivity.
- P. Provide as-built stations and offsets from the main line for all tracer wire valve box locations.

3.03 TRACER WIRE TESTING REQUIREMENTS

- A. The Contractor shall notify the Engineer that the tracer wire is ready for testing.
- B. The Contractor shall retain a third-party specialist to facilitate a continuity test on the tracer wire. The Contractor shall submit a certified report by the third-party testing service stating that the tracer wire is performing satisfactorily.
- C. The Contractor shall perform a continuity test on all tracer wire in the presence of the Engineer. This verification shall be performed upon completion of rough grading and prior to final pavement.
- D. All tests made must be reviewed and approved by the Engineer before the Work is accepted. The Engineer reserves the right to spot check any or all tests performed. All construction defects must be repaired and retested before the final acceptance is made.
- E. If the tracer wire is found to be not continuous after testing, the Contractor shall repair or replace the failed segment of the wire as specified herein to the satisfaction of the Engineer at no additional cost to the Owner.

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The following list of components and areas of work is a summary of the work required in the Drawings and Specifications. The list is not comprehensive of the total work required nor is it in any specific order. It is merely being provided as an aid to the bidder. Work not listed herein, but described in the plans or Specifications, is also part of the overall scope of work.
1. NEMA 3R Utility Metering with Main Breaker and Generator Breakers.
 - a. Circuit breakers with electronic trip units for those breakers above a specified voltage and current trip level.
 2. Power Distribution Switchboard, ATS and Low Voltage Transformer and panelboard, NEMA 1.
 - a. Circuit breakers with electronic trip units for those breakers above a specified voltage and current trip level.
 3. Wallmount NEMA 12 Booster Pump Control Panels:
 - a. Motor controls with variable frequency drive.
 - b. Miscellaneous equipment as shown on Contract Drawings.
 - c. Provisions for future control panel.
 4. Dual fuel Standby Engine Generator with weatherproof sound attenuating enclosure (BID ALTERNATIVE).
 - a. Provisions for future parallel generator(s).
 5. PLC Control panel(s).
 - a. Hardware, Software, Configuration and Programming of the PLC System and SCADA System is by Integrator – a person or entity further defined in this section.
 6. PLC, OI, and SCADA Applications Programming:
 - a. Configuration and Programming of the Programmable Logic Controller (PLC), and Operator Interface (OI), and SCADA System is by Application Programmer. Application programmer is defined in this specification section [Qualifications].
 - b. Application Programmer work is limited to programming and testing (labor only) of the PLC, OI, and SCADA. All other material, assembly, and installation is by Contractor.
 - c. Pre-energization and pre-operational testing must be complete prior to Application Programmer arrival for start-up services. Instrumentation calibrations and I/O checkout must be complete.
 - d. Application Programmer will be available to startup systems as they become available. The Contractor shall notify the Application programmer of start-up and testing dates 2 weeks minimum in advance of requirement.
 7. Instrumentation
 - a. Systems Integrator to design, furnish, assemble, wire, test, and complete all test forms pertaining to instrumentation as part of their scope of work.
 - b. Furnish NSF/ANSI 61 certified products that have undergone testing for any device, valve, instrument, or assembly that will come into contact with drinking water.
 - c. Furnish mounting supports or other accessories as detailed and as recommended by the instrument manufacturer for the application.
 8. Conduit, junction boxes, pull boxes, wire, and grounding system, for equipment interconnection, and operation.
 - a. Contractor to perform termination of all field wiring and internal wiring for equipment that required dis-assembly for shipping.

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- b. Contractor to label conduits, wire, and equipment per specifications.
 - 9. All necessary process piping, shut off, sample and calibration valves, drains, pressure reducers and calibration equipment for connection of instrumentation.
 - 10. Trenching, backfilling, compaction and resurfacing for all new underground conduit routes, concrete pads, and pull boxes.
 - 11. Coordination and equipment for connection of power utility and telephone services per utility Drawings and standards.
 - 12. Site electrical devices, lights and receptacles.
 - 13. Seismic Anchorage Design Calculations and conforming installation.
 - 14. System startup, calibration, testing and documentation.
- B. Electro-mechanical equipment to be installed in this project may be specified in other divisions but will interface to equipment provided under Electrical Specifications. Obtain submittals for those devices, review, coordinate and provide all interfacing equipment, software, communications, I/O, and testing to integrate the equipment to the extent possible and as intended.
- C. Install electrical and control portion of electro-mechanical equipment specified in other sections. Reference those Specifications, pertinent details, and follow all manufacturer instructions to erect, install and commission equipment. Furnish all electrical equipment, interconnecting wire, and make connections to place equipment in operation.
- D. All electrical equipment and materials, and methods - including installation, calibration, and testing - shall conform to the applicable codes and standards listed in this and other Sections. All electrical materials and work shall conform to published standards of the National Electric Code (NEC) current issue, Institute of Electrical and Electronic Engineers (IEEE), and Underwriters Laboratories Inc (UL).

1.02 RELATED SPECIFICATIONS

- A. The following specification sections are part of the [Electrical Specifications].

Section	Description
16110	Conduit and Boxes
16120	Low Voltage Wire and Data Cable
16210	Engine Generator
16250	Automatic Transfer Switch
16430	Low Voltage Switchboard
16450	Grounding
16470	Panelboard and Power Transformer
16481	Variable Frequency Drive
16600	Factory and Field Testing
16630	Electrical System Analysis
16905	Control Panels
16910	PLC & OI Hardware
16940	Instrumentation

- B. Owner, Engineer, Construction Manager, and City are used within Electrical Specifications and are interchangeable. They are all representatives of the Owner, in this case, the City of Orland.

1.03 QUALIFICATIONS AND REQUIRED WORK SCOPE

- A. Electrical Contractor / Certified Electrician
 - 1. Management and installation of the entire electrical and control system required for this project shall be by an Electrical Contractor or Certified Electrician (EC/CE) meeting qualifications as defined herein.
 - a. An approved qualifications submittal is required for EC/CE prior to doing work on project. See [Submittals] herein, this section.
 - 2. EC/CE shall select, furnish, and install all commodity electrical materials (conduit, wire, supports, fittings, ductbanks, etc) that are generally not “custom” or uniquely manufactured for this project. Custom electrical panels, controls, and instrumentation shall be furnished by Systems Integrator but installed by EC/CE.
 - 3. The EC/CE shall meet the following minimum qualifications:
 - a. Has a current C10 Electrical Contractor’s License and/or project Foreman who is a California Certified Electrician issued by the State of California Department of Industrial Relations.
 - b. EC/CE shall comply with State law which requires that all personnel installing electrical components are certified by the State of California as “Electrician” or “Electrician Trainee.” Trainees may install electrical components only under direct supervision of a certified Electrician.
 - c. EC/CE shall have sufficient qualified personnel to staff the project and meet the construction schedule as defined by the Contract requirements or as approved during the submittal process.
 - d. EC/CE shall be regularly engaged in similar industrial power and controls electrical work.
 - e. EC/CE shall have successfully performed work of similar or greater complexity (as measured in contract value on industrial power and controls projects) on at least three (3) previous projects.
 - f. EC/CE must be competent in performance, supervision and coordination of work required and performed by equipment suppliers or other specialty subcontractors.
 - g. EC/CE shall be capable of looking at electrical equipment submittals, prior to installation, comparing hookup requirements to the Drawings, and notifying Engineer of any deficiencies.
 - h. EC/CE shall be competent in methods and materials execution and selection associated in the type of electrical and instrumentation work indicated in Drawings and specified in this Division.
 - i. EC/CE shall be familiar with and understand codes and requirements from NFPA70, NFPA110, and all other governing national or local codes.
 - j. EC/CE shall know and understand common terms and abbreviations used in this Industry. Not all terms and abbreviations will be defined in the Drawings and Specifications.
 - 4. If the EC/CE does not meet the qualifications, the EC/CE may be stopped from doing further work, rejected, removed, and/or required to meet qualifications prior to the resumption of work.
- B. System Integrator
 - 1. Systems Integrator shall be a supplier to the Electrical Contractor and must be competent in performance, supervision and coordination of work required in this contract.

2. This includes, but is not limited to, all work necessary to select, furnish, construct, supervise installation, configure, calibrate, test, and place into operation all transmitters, instruments, programmable controllers, control panels, motor controls, alarm equipment, communications, monitoring equipment, and accessories.
3. The System Integrator shall have on staff a Project Engineer with three years prior experience on similar sized projects. This Project Engineer shall coordinate the technical aspects of this project and prepare the submittals and drawings. The Project Engineer shall attend all coordination meetings when specifically requested by the Engineer.
4. The System Integrator (SI) shall meet the following minimum qualifications:
 - a. SI shall be regularly engaged providing electrical and control systems for the Municipal Water and Wastewater Industry.
 - b. SI shall have an Electrical Engineer on staff registered in the State of California as a Professional Engineer.
 - c. SI shall be capable of labeling all electrical panels as manufactured or customized by the System Integrator with appropriate Underwriters Laboratories (UL) label prior to factory testing or shipment to project site.
 - d. SI shall have successfully completed work of similar or greater complexity and on similar facilities on at least ten previous projects under the present company name.
 - e. SI shall be actively engaged in the following disciplines for the last 5 consecutive years.
 - 1) Design and manufacturing of custom Control Panels, Motor Controls Centers, and associated devices and equipment as specified in this division.
 - 2) Programming and commissioning of SCADA, PLC and Operator Interface hardware.
 - 3) Instrumentation - selection, purchase, calibration, start-up and commissioning.
 - 4) Testing, calibration, start-up, and commissioning of control systems as applied to the Water and Wastewater industry.
 - f. SI shall employ personnel on this project who have successfully completed ISA or equal training courses on general purpose instrumentation.
 - g. SI shall have a permanent, fully staffed and equipped service facility within 200 miles of the project site for a minimum of 1 year prior to bid date with personnel and equipment required to maintain, repair and calibrate the instrumentation system.

C. Application Programmer

1. The Applications Programmer will be a part of the Construction Management team and their work is not in contract.
2. The Application Programmer work is limited to programming and configuration, and associated startup and testing services of the PLC, Operator Interface, and SCADA. All other work is by Contractor.

1.04 CONTRACT DOCUMENTS

- A. The resolution of conflicting information within the contract electrical documents shall put precedence on electrical Drawings over that of electrical Specifications.
- B. The Drawings and Specifications are intended to be descriptive of the type of electrical system to be provided with sufficient detail to construct. Minor omission of detail shall not

relieve a qualified contractor from the obligation to provide a complete operational system if it can be determined that the particular detail is usual and customary for similar systems.

- C. The following Specifications may incorporate specific equipment or materials that do not have equal equipment listed. These items are standards because of their familiarity, serviceability, and/or spare parts inventory. However, equal alternate equipment or materials (noted in the submittal cover letter) will be considered for use on this project if submitted. The Engineer may reject said equipment for the purpose of adherence to standards.
- D. Contract Drawings are diagrammatic and indicate general arrangement of systems and equipment.
 - 1. Exact locations and layouts of electrical products shall be defined during submittal, assembly, or field fit during construction. Field measurements take precedence over dimensioned drawings. Drawing intent is to show initial size, capacity, approximate location, orientation, and general relationship of equipment in area shown but may not show exact detail or arrangement.
 - 2. However, when materials, locations, sizes, or methods are specifically dimensioned, detailed or noted, the Drawings shall take precedence over electrical Specifications in the event of conflict. In no case, is NEC, UL, or other applicable governing standards to be overridden.
- E. The Contractor shall examine the architectural, mechanical, structural, and electrical and instrumentation submittals and equipment furnished under other Specifications divisions in order to determine conduit routing, stub-up locations, and final terminations for all conduits and cables. Conduits shall be stubbed up as near as possible to equipment electrical terminals. The exact locations and routing of cables and conduits shall be governed by structural conditions, physical interferences, and the physical location of wire terminations on equipment.
- F. All equipment shall be installed and located so that it can be readily accessed for operation and maintenance. If accessibility appears to be compromised, the location of equipment or stub ups shall be modified to the extent possible.
- G. Where conduits are shown on the Drawings, or stated to be furnished but not explicitly shown, as part of the scope of work; the Contractor shall provide all fittings, boxes, wiring, etc. as required for completion of the raceway system in compliance with the NEC and the applicable Specifications in this Section.
- H. No changes from the Drawings or Specifications shall be made without written approval of the Engineer. Should there be a need to deviate from the Contract documents, submit written details and reasons for all changes to the Engineer for review.
- I. The Contractor shall maintain a neatly and accurately marked full size set of Contract Drawings recording the as built locations and layout of all electrical and instrumentation equipment, routing of raceways, junction and pull boxes, and other diagram or drawing changes. Drawings shall be kept current weekly, with all "change orders", submittal modifications, and construction changes shown. Drawings shall be subject to the inspection by the Engineer at all times, progress payments or portions thereof may be withheld if Drawings are not accurate or current.
- J. When documents are changed, they shall be marked with erasable colored pencils using the following coloring scheme:

1. Additions - red
2. Deletions - green
3. Comments - blue
4. Dimensions - black

K. Prior to acceptance of the work, the Contractor shall deliver to the Engineer one set of record full size drawings neatly marked accurately showing the information required above.

1.05 UTILITY COORDINATION AND FEES

- A. All fees and charges of the Power Utility Pacific Gas & Electric (PG&E), for design and final connection will be paid by others.
- B. Coordinate all work with the Utility for the work shown on Contract Drawings.
1. Unless already completed, apply for electric service within 10 working days from Notice to Proceed.
 2. Coordinate and meet with the Utility's Representative at the project site(s) within 30 days after award of contract.
 3. Discuss specific installation and comply with Utility requirements. Contact Engineer in the event that Utility requirements far exceed allowances in the plans and Specifications. Provide an itemized list of deviations and potential costs or credits.
 4. Coordinate and obtain required inspections prior to backfill. Make corrections to installation as required.
 5. Coordinate connection and date of service with Utility. Utility back-charges due to mis-coordination or installation problems will be Contractor responsibility to pay and correct.
- C. Furnish and install electric service in accordance with the serving Utility's requirements.
1. The contract plans show the preliminary design for the Utility installation. Slight changes required by the Utility do not constitute extra work unless cost impacts in material and labor exceed \$5000. In that event, the agreed excess amount will be allowed as a contract change.
 2. The Contractor shall provide and install service entrance equipment, all material, conduits, wiring, pull ropes, pole risers, transformer pads, bollards, etc. as shown on Utility design drawings and standards for new power service. Utility standards are available upon request from the Utility or for download from the Utility's website.
 3. The Utility will provide and install primary wire, transformer, meter, and connections.
- D. Following award of Contract, schedule all service installations and connections with utilities. Construction or start-up delays as a consequence to lack of documented effort by the Contractor which delay the project completion due to lack of Utility services will not be considered valid and Contract liquidated damages may be assessed.

1.06 PROJECT COORDINATION

- A. Prior to submittal, the Electrical Contractor shall coordinate with equipment suppliers to verify sizes, mounting, connections, storage, and delivery of equipment. If there are any issues whereby the solution will be in conflict with plans and Specifications, or that are undefined and need direction, they shall be brought to the attention of the Engineer or Construction Manager via the RFI process.

- B. Where connections must be made to existing or new operational facilities, the Contractor shall schedule all the required work with Engineer, including the power shutdown period. Carry out each shutdown so as to cause the least disruption to the operation of the installation.
 - 1. The Contractor shall limit all unscheduled shutdown periods to less than 15 minutes and only with prior approval of the Station operator.
 - 2. Carry out shut downs of durations greater than 15 minutes only after the time and date schedule and sequence of work proposed to be accomplished during shutdown has been favorably reviewed by the Engineer. Submit shutdown plans at least 2 days in advance of when the scheduled shutdown is to occur.
 - 3. Provide temporary power to all existing facilities utilizing a portable generator. The generator shall be utilized for all shutdowns that exceed 15 minutes and run continuously for the duration of the primary power shutdown. All cost for operating the generator including equipment, fuel and labor shall be provided.
 - 4. The Engineer reserves the right to delay, change, or modify any scheduled shutdown at any time, at no additional cost to the Owner, when the risk of such a shutdown would jeopardize the operation of the water distribution system and/or water plant operation.

1.07 SUPERVISION

- A. The Contractor shall schedule all activities, manage all technical aspects of the project, coordinate submittals and drawings, and attend all project meetings associated with this Section. The Contractor shall coordinate and confirm that the project schedule is being adhered to and all work is being completed within the scheduled time frames.
- B. The Contractor shall supervise all work in this Section, including the electrical system general construction work, from the beginning to completion and final acceptance.
- C. The Contractor shall coordinate, obtain, prepare, and/or complete the documentation required within this division. All documentation shall be complete and delivered prior to final acceptance.

1.08 INSPECTIONS

- A. General
 - 1. Contract work or materials shall be subject to inspection at any time by the Engineer. If equipment, material, or installation method does not conform to the Contract documents, or does not have a favorably reviewed submittal status and has been determined to be unsatisfactory by the Engineer, then the Contractor shall remove said material from the premises; and if said material has been installed, the entire expense of removing and replacing same, including any cutting and patching that may be necessary, shall be borne by the Contractor.
 - 2. The Engineer may inspect and test the fabricated equipment at the factory before shipment to job site. See Electrical Specifications [Factory and Field Testing] for requirements.
 - 3. Work shall not be closed in or covered over before inspection and approval by the Engineer. All costs associated with uncovering and making repairs where non-inspected work has been performed shall be borne by the Contractor.
 - 4. The Contractor shall cooperate with the Engineer and provide assistance at all times for the inspection of the electrical system under this Contract. The Contractor shall remove covers, provide access, operate equipment, and perform other reasonable work which, in the opinion of the Engineer, will be necessary to determine the quality of the work.

- B. Milestones requiring inspection and signoff.
 - 1. Underground conduit and grounding system complete. Do not cover any portion of conduit prior to inspection. Conduits must be labeled with temporary tags per Electrical Specifications [Conduit and Boxes] and [Grounding].
 - 2. Factory testing. Coordinate test date with Engineer 2 weeks prior to test scheduled date.
 - 3. Installation of electrical equipment. Equipment is anchored in place, conduit connections are complete, no wire is yet pulled into conduit. Permanent conduit tags must be in place per Electrical Specifications [Conduit and Boxes] and [Grounding].
 - 4. Wire termination complete. Do not energize equipment. All wire tags must be installed and wires terminated per Electrical Specifications [Low Voltage Wire and Data Cable]. Pre-energization testing to commence after inspection.
 - 5. Punch list – final inspection. Schedule final walkthrough with Engineer one week prior to intended project completion date. All items on punchlist must be complete prior to scheduling walk-through.

1.09 JOB CONDITIONS

- A. Construction Power and Telephone Service
 - 1. The Contractor shall coordinate, furnish and install, temporary utility services required during construction of the project, such as temporary electrical power and telephone service. Temporary services shall be installed in accordance with the applicable codes and regulations of the serving utilities.
 - 2. Upon completion of the project, remove temporary services. All equipment and material shall be the property of the Contractor.
- B. Equipment Storage
 - 1. The Contractor shall provide adequate protection for all equipment and materials during shipment, storage and construction.
 - 2. Equipment and materials shall be completely and sufficiently sealed and covered and set on a pallet above grade so that they are protected from weather, wind, dust, water, or construction operations.
 - 3. Equipment shall not be stored outdoors. Where equipment is stored or installed in an area with susceptibility to moisture, such as unheated buildings, untested piping, etc., provide an acceptable means to prevent moisture damage, such as plastic cover and a uniformly distributed heat source to prevent condensation.
- C. The project site is located where outside temperatures vary between 10 deg F. to 110 deg F. Humidity in this area will range from 10% to 100%.

1.10 AREA CLASSIFICATIONS

- A. Area classifications are shown on the site electrical plans. The area enclosed by walls or the entire drawing area shall be classified as shown unless otherwise described in notes.
- B. All electrical equipment, enclosures, conduit, and supports shall be formally rated for or, at minimum, meet the intent of the rating as interpreted by Engineer.
- C. If no area classification rating is shown on the Drawings, classification shall default to a NEMA 12 rating for indoors, and NEMA 4 rating for outdoors (non corrosive) and NEMA 4X for corrosive areas both indoors and outdoors.

1.11 SUBMITTAL REQUIREMENTS

A. General

1. Requirements described herein are specific to electrical submittals and are secondary to those described in other general Specifications sections. Any additional requirements described here that are beyond those described in those sections shall be provided as described. Conflicts shall be resolved by giving priority to general Specifications.
2. The Contractor shall ensure that the System Integrator and/or equipment suppliers provide the submittal documentation required in this section. Submittals shall be neat, orderly, complete (without un-needed parsing), and indexed.
 - a. Like equipment shall be submitted complete in a single submittal. For instance, all general electrical materials shall be in a single submittal. All instrumentation, all control panels, or all MCCs and so on shall be submitted complete where possible.
 - b. Submittals that are broken down without sufficient cause will be rejected for future inclusion into a combined submittal.
 - c. Do not separate submittals by area.
 - d. Do not separate submittals by specification division unless agreed to in advance.
 - e. Submittals for work scope covered in this contract are expected to be as follows. This list is intended to be a guideline and not to be specific of all submittals required. Project circumstances or leadtimes or availability will each impact the order and division of submittals.
 - 1) General electrical materials – conduit, wire, labels, etc.
 - 2) Power Distribution and Motor Controls
 - 3) PLC and Control Panels
 - 4) Engine Generator
 - 5) Seismic Calculations
 - 6) Instrumentation
 - 7) PLC Programming
 - 8) Factory and Field Testing forms and procedures
 - 9) Arc Flash Calculations
 - 10) O&M Manuals
3. The Contractor shall coordinate submittals with the work so that project will not be delayed. This coordination shall include scheduling the different categories of submittals, so that one will not be delayed for lack of coordination with another. Time extensions will not be allowed due to failure to properly schedule submittals.
4. No material or equipment shall be delivered to the job site until the submittal for such items has been reviewed by the Engineer and marked "no exceptions noted" or "make corrections noted".
5. The equipment Specifications have been prepared on the basis of the equipment first named in the Specifications. The Contractor shall note that the second named equipment, if given, is considered acceptable and equal equipment, but in some cases additional design, options, or modifications may be required to meet Specifications or functional installation.
6. Exceptions to the Specifications or Drawings or equipment or procedures submitted as "equal" to specified equipment shall be clearly identified in a letter at the front of the submittal. Submittal data for "equal" equipment or procedures shall contain sufficient details so a proper evaluation may be made by the Engineer. The Contractor is responsible for verifying proper application/operation of substituted equipment.

7. The opinion of the Engineer will be the final determination whether a substitution request meets the design intent.
 8. Deviations from the Contract documents shall not be incorporated into the work without prior written approval of the Engineer. A "Change Order" directive from the Engineer is required prior to incorporating any deviation from the Contract documents that has costs associated. The cost differential associated with this change order must be negotiated with the Owner to amend the Contract to reflect the costs or savings.
- B. Submittal Procedures
1. Identify all submittals by submittal number on letter of transmittal. Submittals shall be numbered consecutively and resubmittals shall have a letter suffix. For example:
 - a. 1st submittal: 1
 - b. 1st resubmittal: 1A
 - c. 2nd resubmittal: 1B, etc.
 2. Within 30 calendar days after contract award maximum and as the construction schedule dictates, the Contractor shall furnish to the Engineer all submittals (electronic) required for this Division. Interconnection drawings, training documents test procedures, and O&M Manuals as applicable shall be submitted timely as to not delay the project.
 - a. Submittals shall be delivered entirely electronically via email (no hard copy required). However, General Contractor supervision must not be circumvented by sending submittals direct to Engineer.
 - b. Electronic Submittals shall be viewable using a PDF reader.
 - c. Electronic (PDF) submittals must follow all applicable requirements for indexing, bookmarks, highlighting, selection indicators (box, highlight) etc. Use of native PDF files (not scans) are required if one exists on the World Wide Web (WWW).
 3. Submittal Preparation
 - a. Electronic submittals shall be assembled in accordance with the Specifications with table of contents, bookmarks, tabs, subtabs, etc. utilizing the electronic bookmarks feature available in the PDF assembler. Only one PDF file is allowed for each submittal. Multiple (.PDF) files will not be acceptable.
 - b. Use of native PDF files (not scans) are required if one exists on the www. Ignoring this requirement is cause for submittal rejection.
 - c. Submittal shall be appropriately labeled with the project name, contract number, equipment supplier's name, specification section(s), and major material contained therein.
 - d. An index shall be provided. This index shall itemize the contents of each tab and subtab section.
 - e. Field equipment shop documents, panel equipment shop documents, drawings, and bill of materials shall be grouped under separate tabs. Shop documents shall be ordered in the same sequence as their corresponding Contract specification subsection.
 - f. All spare parts shall be listed separately at the end of the Bill of Materials list.
 - g. Data summary sheets shall be provided for each individual piece of instrumentation. The data summary sheets shall have the following information preceding their corresponding catalog data:
 - 1) Instrumentation type and tag name.
 - 2) Location/description.
 - 3) The manufacturer's model and part number with all options.

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- 4) Range, span, units, input and output signals.
 - 5) Description of component.
 - 6) Contract specification subsection number reference.
4. The reviewed submittals will be annotated "Make Corrections Noted", "No Exceptions Noted", "Revise and Resubmit Noted Items", or "Rejected without Review." The following actions shall then be taken by the Contractor:
- a. "No Exceptions Noted" - The Contractor may proceed with the work covered in this submittal. No resubmission is necessary.
 - b. "Make Corrections Noted" - The Contractor may proceed with the work covered in this submittal incorporating the changes noted. However, the Contractor shall revise the submittal in accord with the changes noted and resubmit six (6) copies of drawings, bill of materials, and catalog data denoting changes within 14 calendar days when requested by the Engineer for record keeping purposes.
 - c. "Revise and Resubmit Noted Items" - The Contractor shall not proceed with the work covered in this submittal. The Contractor shall revise and correct the submittal in accordance with the comments and resubmit six (6) copies within 14 calendar days for approval.
 - d. "Rejected without Review" submittal - The Contractor shall not proceed with the work covered in this submittal. The submittal did not address the work scope as defined by the submittal's title or the previous submittal comments have not been addressed in full. The Contractor shall revise and correct the submittal in accordance with the Specifications, and resubmit six (6) copies within calendar 14 days for approval.
5. Resubmittals shall address all comments by the Engineer. A submittal response letter shall be submitted that addresses each comment by the Engineer with a standardized response of "revised" or with a written explanation. Partial re-submittals (that do not address all comments) may be returned without review at the discretion of the Engineer.
6. The Contractor shall be responsible for the Engineer's review cost for each resubmittal in excess of the second resubmittal. These costs will be back-charged to the Contractor and will be deducted from his progress payments.
- C. Electrical Equipment -- Submittal data shall be grouped by equipment type. Each submittal shall be as complete as possible covering the entire project and scope of supply. Drawings or equipment submitted individually that are not on the critical path will not be accepted for individual review. The electrical submittals shall include (as a minimum):
- 1. Table of Contents
 - 2. Comment Letter: The Project Engineer of the System Integrator shall note all deviations from Contract Documents and the reason(s) for the deviation. They may use this forum to inform the Engineer or installing Contractor of important information related to the project. RFIs must be submitted separately. Re-submittals shall include written responses to every comment provided by the Engineer during the previous review.
 - 3. Bill of Materials: The Contractor and System Integrator each shall provide Bill of Material for electrical components formatted as shown below. Generic names or part numbers as defined by a distributor or Integrator are not acceptable. Only the originating manufacturer's name and part number shall be listed. Provide separate bill of materials for each panel, MCC, instrument list, etc.

Bill of Material

Item #	Qty	Tag#	Description	Manufacturer	Part #
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- 4. Shop Drawings:
 - a. Equipment elevations with enclosure details drawn to scale or dimensioned with relative scale.
 - b. Electrical One-line, Elementary, and wiring diagrams
 - c. PLC I/O wiring diagrams
 - 5. Catalog Data shall include the following: (features and options shall be highlighted, circled, or "arrowed.")
 - a. Instrumentation data summary sheets (by Contractor)
 - b. Manufacturer's technical information brochure
 - c. Physical size and mounting details and illustrations
 - d. Calibration Range
 - e. Input/output signals
 - f. Electric power, air, and/or water supply requirements.
 - g. Options selected and available (Cross out items not included)
 - h. Materials of construction of components
 - 6. Program Software Documentation
 - a. Programming documentation
 - b. Programming code native files
- D. Shop Drawings Shop drawings shall be furnished for each electrical panel even if one was not shown explicitly on the Drawings. Shop drawings shall be numbered in sequence. Blank drawings or drawings that contain no specific project data will not be accepted for review.
- E. All drawings shall be generated with a computer utilizing AutoCAD or similar drafting program. Drawings shall be no smaller than 11" x 17". The lettering shall be legible and no smaller than 0.75 inch in height.
- F. Drawings shall be custom prepared for this project and shall have borders and a title block identifying the project, manufacturer, system or location, drawing number, drawing title, AutoCAD file name, project engineer, date, revisions, and type of drawing. Diagrams shall carry a uniform and coordinated set of wire colors, wire numbers, and terminal block numbers. The shop drawings shall include the following as a minimum:
- 1. Electrical one-line diagrams detailing all devices associated with the power distribution system. The following applicable information or data shall be shown on the one- or three- line diagram: location, size and amperage rating of bus; size and amperage rating of wire or cable; breaker ratings, number of poles, and frame sizes; power fail and other protective devices; fuse size and type.
 - 2. Detailed analog and digital I/O diagrams showing the wiring requirements for each instrument or device connection. Reference the Drawings for an example of each I/O card drawing requirements. If one is not included in the Drawings, then one may be obtained from the Engineer upon request.
 - 3. Elementary (wiring) diagrams shall be provided for all relay logic, programmable logic controls, motor controls, power supplies, and other wiring. All elementary (wiring) diagrams shall be drawn in JIC EMP/EGP format and standards showing ladder rung numbers and coil and contact cross referencing numbers.
 - 4. Equipment exterior and interior scaled drawings of front, side, elevation, deadfront, front panel devices, and backpan components. Show fabrication methods and details; including material of construction, paint color, door latch and lock, and ventilation system. Show shipping split locations and offloading

information. Submit base plan showing allowed conduit entrance areas and bolt hole locations.

5. Drawings shall show UL required information as needed to UL label the equipment in accordance with UL procedures for label applied.
6. Submit full size drawing of all nameplates and tags, as specified herein, to be used on project. Submittal to include the following:
 - a. Dimensions of nameplate.
 - b. Exact lettering and font for each nameplate.
 - c. Color of nameplate.
 - d. Color of lettering.
 - e. Materials of construction.
 - f. Method and materials for attachment.
 - g. Drawing showing location of nameplates on each, panel and enclosure.

G. Seismic Anchor Design Calculations

1. All switchgear, motor controls centers, transformers, cabinets, raceways, supports, and electrical materials shall be so installed as to remain in a secure and captive position when subjected to a horizontal force in accordance with the current, applicable, and more stringent of current California Building Code (CBC) or International Building Code (IBC) requirements. Method of securing shall constrain equipment against both vertical and horizontal forces and overturning forces.
2. Calculations as prepared by a structural engineer registered in the State of California shall be submitted in accordance with code requirements for earthquakes forces on all specified equipment. Calculations shall include wind loading forces for equipment installed outdoors.
3. Provide a submittal, minimum 3 weeks prior to equipment installation, of calculations, materials needed, and supporting drawings and details for installation by Contractor.

1.12 OPERATING AND MAINTENANCE INFORMATION

A. Operational Training

1. At time of completion, the Contractor shall provide a period of not less than 6 hours training for instruction of operation and maintenance personnel in the use of systems. Instruct all personnel at one time in one session. Make necessary arrangements with manufacturer's representative. Provide product literature and application guides for user's reference during instruction.

B. Operations and Maintenance Manuals

1. Provide Operation and Maintenance manuals per Specifications as described in "Submittal Requirements" in this section with the following additional requirements:
 - a. A comprehensive index.
 - b. A complete "Record" set of favorably reviewed electrical submittals as provided under subsection "Submittal Requirements" illustrating all components, piping, and electrical connections.
 - c. A complete list of the equipment supplied, including serial numbers, ranges, catalog cuts, and pertinent data.
 - d. Full Specifications on each item.
 - e. Detailed service, maintenance and operation instructions for each item supplied. Schematic diagrams of all electronic devices shall be included. A complete parts list with stock numbers shall be provided for the

- components that make up the assembly. All of these shall be originals, no copies.
- f. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
 - g. Shop drawings in native file format and updated to reflect as-built conditions.
 - h. Application programs, configurations, calculations, documents or other computer electronic files prepared for this project. Provide all files in native file format such as .dwg, .rss, .xls, .doc, etc.
2. Submit electronic readable PDF file format (email with attachments or download links) of the proposed O&M manuals for review by the Engineer. Submittals shall be delivered timely to the Engineer to allow for review period, corrections, and re-submissions as necessary.
- a. General Contractor supervision must not be circumvented by sending submittals direct to Engineer.
 - b. O&M Submittals shall be published 1st electronically and 2nd on hard copy paper stock.
 - c. Electronic Submittals shall be transmitted with the hard copy submittals and be viewable using a PDF reader.
 - d. Electronic submittals shall be assembled in accordance with the Specifications for hard copy submittals with table of contents, bookmarks, tabs, subtabs, etc. utilizing the electronic bookmarks feature available in the PDF assembler.
 - e. Electronic (PDF) submittals must follow all applicable requirements for hard copy submittals including indexing, item selection indication, bookmarks, etc.
3. Provide four (4) hard copy O&M manuals per Specifications as described in SUBMITTALS REQUIREMENTS in this section.
- a. Deliver approved hard-copy O&M manuals to the project site and Owner prior to pre-operational testing or equipment start-up.
- C. At the end of the project hard copy and soft copy electronic PDF files, shall be updated to "as-built" conditions.

PART 2 PRODUCTS

2.01 QUALITY

- A. All equipment and materials shall be new, in current production, and the products of reputable suppliers having adequate experience in the manufacture of these particular items. For uniformity, only one manufacturer will be accepted for each type of product.
- B. Products specified that have become obsolete (out of current manufacturing, or have been superseded by another product) shall be cross-referenced to a replacement product(s) and provided in lieu of the specified product(s) for no additional cost. Under no conditions, shall products be submitted or furnished that are known (on manufacturer's list of obsolescence) and expected to be removed from current production within 12 months after project submittal. Products found to have been furnished this way will be removed and replaced at Contractor's expense.
- C. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection, and continuous or intermittent operation. All equipment shall be

adequately braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, and shall be of sturdy and durable construction suitable for long, trouble free service. Light duty, fragile and competitive grade devices of questionable durability shall not be used.

- D. Products that are specified and include a manufacturer, trade name or catalog number are intended to establish a standard of quality, performance, warranty and service. Products that are specified "or equal," do not prohibit the use of equal products of other manufacturers provided they are submitted, identified and promoted as equal, and favorably reviewed by the Engineer prior to procurement and installation.
- E. Products submitted as "equal" to the named products will be reviewed for conformance with the Specifications and in comparison with the first named product. If the equal product meets Specifications, but does not have a feature or performance characteristic that is available with the first named product, and that feature or performance is required for this project, then the submitted equal product may be rejected on those grounds.
- F. In the event that some claims of the manufacturer of submitted "equal" product are called into question by the Engineer, the Contractor, may be required to prove those claims either prior to installation or during startup of product. If the product does not meet the claims made or Specifications, the product may be rejected by the Engineer and a replacement product must be submitted by the Contractor in its place. All cost for the rejected product, installation, testing, and removal will be the responsibility of the Contractor.
- G. Underwriters Laboratories (UL) listing is required for all substituted equipment when such a listing is available for the first named equipment. Extra parts, labor, panel space, power supplies, circuit breakers, and/or GFIC devices shall be provided as necessary for incorporation of specified non-UL components.
- H. When required herein or requested by the Engineer, the Contractor shall submit equipment or material samples for test or evaluation. The samples shall be furnished with information as to their source and prepared in such quantities and sizes as may be required for proper examination and tests, with all freight and charges prepaid. All samples shall be submitted before shipment of the equipment or material to the job site and in ample time to permit the making of proper tests, analyses, examinations, rejections, and resubmissions before incorporated into the work.

2.02 NAMEPLATES & TAGS

- A. Equipment exterior nameplates Nameplate material shall be rigid laminated black plastic with beveled edges and white lettering; except for caution, warning, and danger nameplates the color shall be red with white lettering. The size of the nameplate shall be as shown on the Drawings. No letters are allowed smaller than 3/16". All nameplates located outdoors shall be UV resistant. Securely fasten nameplates in place using two stainless steel screws, type 316L, if the nameplate is not an integral part of the device. Epoxy cement or glued on nameplates will not be acceptable. Engrave the nameplates with the inscriptions as approved by the Engineer in the submittal.
 - 1. For each major piece of electrical equipment provide a manufacturer's nameplate showing the Contract specified name and number designation, and pertinent ratings such as voltage, # of phases, ratings, etc.

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2. For each device with a specific identity (pushbutton, indicator, instrument, etc.) mounted on the exterior or deadfront of a piece of equipment provide a nameplate with the inscription as shown on the Drawings and described herein.
 3. Where required by code, provide nameplates denoting information required. For example:
 - a. Transformers not in sight of disconnect, furnish nameplate denoting location of feeding circuit breaker or disconnect.
 - b. Motor controls without door interlock or disconnecting circuit breaker; furnish nameplate denoting location or feeding circuit breaker or disconnect.
 4. Where no inscription is indicated on the Drawings or described herein, furnish nameplates with an appropriate inscription providing the name and number of device.
 5. Install Safety Signs in accordance with the latest OSHA requirements.
 - a. Entrances to electrical rooms and stations: Danger Sign requirements, ELECTRICAL ROOM, HIGH VOLTAGE (define voltage, example 480 VAC) KEEP OUT, AUTHORIZED PERSONNEL ONLY.
 - b. Equipment enclosures, cable tray and wireway where 120 VAC or higher and 50 V DC and higher exist: Danger Sign requirements, HIGH VOLTAGE (define voltage, example 480 VAC) AUTHORIZED PERSONNEL ONLY.
 - c. Equipment such as motor control centers, control panels, etc., where more than one source may be present in an enclosure or cubicle: Danger Sign requirements, VOLTAGE (define voltage, example 120 VAC control voltage or 480 VAC power) FROM MULTIPLE SOURCES IN THIS ENCLOSURE.
 - d. Equipment such as switchboards, switchgear, panelboards and motor control centers: Warning Sign requirements, WARNING, SERVICE ENTRANCE DISCONNECT FOR 1 OF ___ (define quantity) SERVICES TO THIS BUILDING. OTHER SERVICE ENTRANCE DISCONNECTS ARE LOCATED AT (define locations).
 6. Caution, warning and danger nameplates shall be red with white lettering
- B. Equipment Interior Nameplates Nameplate material shall be clear plastic with black machine printed lettering as produced by a KROY or similar machine; except caution, warning, and danger nameplates shall have red lettering. The size of the nameplate tape shall be no smaller than 1/2" in height with 3/8" lettering unless otherwise approved by the Engineer. Securely fasten nameplates in place on a clean surface using the adhesion of the tape. For each device with a specific identity (relay, module, power supply, fuse, terminal block, etc.) mounted in the interior of a piece of equipment provide a nameplate with the inscription as shown on the Drawings and described herein. Where no inscription is indicated on the Drawings or described herein, furnish nameplates with an appropriate inscription providing the name and number of device used on the submittal drawings. Stamp the nameplates with the inscriptions as approved by the Engineer in the submittal.
- C. Equipment Tags When there is no space or it is impractical to attach an engraved plastic nameplate with screws, as is the case with most field devices and instruments, the Contractor shall attach a tag to the equipment with the same inscriptions as specified above in paragraph A. The tag shall be made from stainless steel material and the size of the nameplate shall be no smaller than 3/8"h x 2"w with 3/16" machine printed or engraved lettering unless otherwise approved by the Engineer. The tag shall be attached to the equipment with stainless steel wire of the type normally used for this purpose.

2.03 FASTENERS

- A. Fasteners for securing equipment to walls, floors, or ceilings, shall be stainless steel. The minimum size fastener shall be 3/8 inch diameter.

2.04 COMPONENTS

A. Switches and Pushbuttons

- 1. Switches (HS) and pushbuttons (HC) for general purpose applications shall be water and oil tight as defined by NEMA 4X, corrosion resistant as defined by NEMA ICS 6 110.58, U.L. listed, standard 30 mm diameter, with plastic holding nut.
- 2. Switches and pushbuttons shall have contacts rated NEMA A600 or 10 amperes continuous and 600 VAC. Provide NO and NC contacts as required.
- 3. Engraved black legend plates shall be provided to define each switch and pushbutton function.
- 4. Selector switch handles and pushbutton caps shall be black unless otherwise noted on drawing. Lock-out stop caps shall be red.
- 5. Selector switches for hand off auto (HOA) applications shall have the hand position to the left, off in center, and auto in the right position.
- 6. Pushbuttons and selector switches in hazardous locations shall have hermetically sealed contacts or explosion proof enclosures.
- 7. Lockout stop pushbuttons shall include padlocking attachment. Pushbutton type shall be coordinated with padlock attachment type.
- 8. Switches and pushbuttons shall be Allen-Bradley 800H, or equal.

B. Indicating Lights

- 1. Indicating Lights for general purpose applications shall be NEMA 4X, corrosion resistant as defined by NEMA ICS 6 110.58, U.L. listed, 30 mm diameter, with plastic lens, plastic holding nut, and miniature bayonet lamp base.
- 2. Lamp shall be full voltage 120 VAC with 28 chip (min) High Intensity LED.
- 3. Indicating lights shall have contacts rated NEMA A600 or 10 amperes continuous and 600 VAC. Provide NO and NC contacts as required.
- 4. Engraved black legend plates shall be provided to define each lights function.
- 5. Indicating light type and color of lens shall as follows or as otherwise shown on the Drawings:
 - a. Open/On Green
 - b. Closed/Off Red
 - c. Alarm Amber or Blue
 - d. Power On White
- 6. Indicating lights designated "PTT" on wiring diagram or shown with push-to-test wiring shall be provided with a push to test switch and wiring.
- 7. Indication lights shall be Allen-Bradley 800H, or equal.

C. Relays and Timers

- 1. General: Relays and timers shall be provided with N.O. or N.C. contacts as shown on the Drawings. All spare contacts shown shall be provided. Contacts shall be rated 10 amps minimum at 120 VAC, 60 Hz unless otherwise shown on the Drawings. Coil voltage shall be 120 VAC unless otherwise described or shown on the Drawings. Relays and timers shall be designed for continuous duty. All relays shall be U.L. listed. All relays and sockets shall be the product of a single manufacturer. The following is a summary of abbreviations associated with relays and timers:
 - a. CR – Control relay

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- b. TR – Timing relay
 - c. TDOE – Time delay on energization
 - d. TDOD – Time delay on de-energization
 - e. PR – Power Relay
 - f. PFR – Phase Fail Relay
 - g. VR – Voltage Sensor Relay
2. Sockets for plug in relays and timers shall be standard industrial type DIN rail mount with barrier type pressure plate screw terminals. Sockets shall be rated 300 VAC, 10 amps minimum.
- a. Blade 8 or 11 pin for coil voltage above 90 volts AC or DC.
 - b. Octal 8 or 11 pin for coil voltage below 90 volts AC or DC.
3. Control relays (CR) shall be plug in type with neon indicating lights and clear see through sealed housing to exclude dust. Provide IDEC Type RR, or equal. Two form C contacts (minimum) shall be provided on each relay.
4. Time delay relays on energization (TR-TDOE) shall be solid state plug in relays with adjustable timer ranges from 1 second to 10 hours selectable unless other ranges are shown. Provide LED timer energized indicator lamp. Time delay relays shall be IDEC RTE, or equal.
5. Time Delay Relays (TR-TDOD)
- a. Time delay relays on de-energization (TR-TDOD) (continuous power control input) shall be solid state plug in relays with a timer adjustable range from 1 second to 10 hours selectable unless other ranges are shown. Provide LED timer energized indicator lamp. Time delay relays shall be IDEC RTE, or equal.
 - b. Time delay relays on de-energization (TR-TDOD) (true off) shall be solid state plug in relays with a timer adjustable range from 1 second to 10 minutes unless other ranges are shown. True off time delay relays shall be IDEC GT3F-2, or equal.
6. Power relays (PR) shall be plug in ice cube type with clear sealed housing to exclude dust.
- a. Applications requiring 3PDT contacts rated 20A or 0.5 HP at 120 VAC (minimum), furnish Magnecraft Type 389FXCXC-120A, or equal.
 - b. Applications requiring SPDT contacts rated 30A or 1.0 HP at 240 VAC, furnish Magnecraft Type 389FXHXC1-120A, or equal.
 - c. Furnish compatible blade type relay socket model 70-788EL11-1 or equal.
- D. Voltage Monitor Relay (VMR)
- 1. The voltage monitor relay (VMR) shall continuously monitor the three phases for power loss, low voltage, phase loss, and phase reversal. The VMR shall interface to the control circuit with DPDT contacts rated for 4 Amps at 120 VAC. The VMR shall have a drop out voltage adjustment, time delay adjustment, and status indicating LEDs. Voltage monitor relay shall be Time Mark 2652, or equal.

2.05 MOTOR CONTROL ACCESSORIES

- A. Control Power Transformer:
- 1. Control power transformer shall be epoxy encapsulated for dust and moisture protection. The internal wiring shall be copper and have 105 deg. C insulation rating. The unit shall feature barriered screw terminals for connection to electrical circuits. Provide with time-delay, slow-blow secondary fuse rated to protect the transformer and interrupt 10,000 amperes at 120VAC. Two primary fuses rated for 480 VAC and AIC as shown in the Drawings shall be provided. Transformer minimum size and voltage ratings shall be as shown on Contract

Drawings. Control power transformer shall be Micron Impervitran, Cutler Hammer MTE or equal.

2.06 DEVICES

A. Switches

1. General purpose commercial grade switches shall be manufactured in accordance with UL 20. Switches shall be one pole, brown, 20 amps at 277 VAC, 1HP at 120 VAC, 2 HP at 240 VAC. Switches shall have copper alloy contact arm with silver cadmium oxide contacts. Switches shall have slotted terminal screws and a separate green grounding screw. Provide Leviton, Hubbel, or equal.
2. Wall mount commercial grade motion detector switches (denoted with M next to switch symbol in Drawings) shall utilize passive infrared detection with 180 deg field of view to determine if the space is occupied by personnel. The device shall be capable of switching incandescent (800W at 120V) and fluorescent (1200VA at 120V) lamps with electronic ballasts. The device shall feature a manual-off-auto switch. A delay off time adjustment shall be settable from 30 seconds to 30 minutes. The device shall incorporate a photocell with light intensity adjustment to keep the switch from activating when light levels are above setting. Provide Leviton, Hubbel, Wattstopper, or equal.
3. Timer Switches (denoted with T next to switch symbol in Drawings) shall provide a variable time range countdown of lighting circuit. Depressing touchplate turns lights on for the dial setting located behind the touchplate. Dial setting ranges of 1 minute to 18 hours shall be attainable. An illuminated LED indicates the load is on and blinking LED accompanied by annunciator sound indicates end of time cycle. Device shall be capable of switching incandescent (600W at 120V) and fluorescent (900W at 120V) lamps with electronic ballasts. Timer Switch shall be Leviton 6652, or equal.
4. Time Clock Switches (denoted with TC next to switch symbol in Drawings) shall provide a programmable automatic time on/off of lighting circuit. Settings each 30 minutes for 24 hours shall be attainable by setting from front of switch. An illuminated LED indicates the load is on. Device shall be capable of switching incandescent (900W at 120V) and fluorescent (1200W at 120V) lamps with electronic ballasts. Timer Switch shall be Leviton 6124, or equal.
5. Thermostat Switches (T in circle on Drawings) shall have a plastic NEMA 4X rated housing with stainless steel temperature sensing coil externally mounted. A face mounted dial shall allow temperature settings for heating and cooling from 40 to 104 deg F. The switch shall be rated for 120/240 volt at 10A inductive/16A resistive, SPDT. Temperature switch shall be Esapco TH15 or equal.
6. Special purpose switches shall be provided with the amperage, voltage, and configuration as shown on the Drawings. Switches used as motor disconnects for single phase motors shall be horsepower rated.

B. Receptacles

1. General purpose receptacles shall be commercial grade, duplex and rated 20 amps, 120 VAC, 2 pole, 3 wire grounding, NEMA 5-20R configuration, specification grade, and side wired to screw terminals. Face color shall be brown when paired with stainless steel covers. General purpose receptacles shall be specification grade Leviton, Hubbel, or equal.
2. Ground fault circuit interrupter receptacles shall be used where noted as GFI on plan or where in outdoor NEMA 3R locations. GFI receptacles shall be commercial grade, duplex, brown, 20A, 120V, back and side wired, with "test"

- and "reset" buttons. "Daisy Chain" connecting multiple receptacles from one GFI unit is not acceptable. GFI receptacles shall be Leviton, Hubbel, or equal.
3. Boxes shown in NEMA 3R environments and outdoor locations shall be weatherproof while in-use. Furnish in-use weatherproof covers and weatherproof boxes for these areas.
 4. Definite purpose receptacles and plugs in NEMA 4 or 4X environments where a receptacle is shown and a device is to be connected continuously, shall be listed as UL type 4, 4X, (Plug) and NEMA 3R (flip cover). Receptacles, plugs, and housings shall be fabricated of impact resistant plastic with o-rings and gaskets to prevent the entrance of water, vapors, and chemicals when unplugged or plugged. Circular plugs shall be retrofitted onto equipment so as to be compatible with the receptacles to maintain in-use ratings. Furnish Hubbel Watertight Wiring Devices and Accessories, or equal.

2.07 DISCONNECTS

- A. Disconnect Switch:
 1. Disconnect Switch shall be heavy duty, horsepower rated, three pole, single throw, fusible/non-fusible with quick make/break operating mechanism. The enclosure shall be 316 stainless steel and rated NEMA 4X. The enclosed switch shall be rated for 480 Volt, and 10HP (minimum) unless otherwise shown on the Drawings. Provide fuses, auxiliary contacts, or indicators as required by the motor control or one-line diagram. The operator shall actuate the switch side mounted handle and have provisions for up to 3 padlocks. Disconnect switch shall be Cutler Hammer DH series, Square D or equal.

2.08 RADIO SYSTEM

- A. ANTENNA POLE
 1. Round tapered steel main section (height per drawings), hot dip galvanized, 11 ga steel thickness, min. Base plate diameter as required to meet performance criteria.
 2. Welded top plate with tenon. The tenon is 2" diameter x 4" long pipe with plain end welded to plate and 2" MNPT threaded opposite end.
 3. Provide 2" galvanized threaded Y adapter and threaded extension pipe and lighting rod per details.
 4. Hand hole near base, 5" x 7" minimum. Ground lug accessible within.
 5. Anchor Bolts: Galvanized "L" anchors with 2 hex nuts and 2 washers per bolt for leveling. Provide 2-piece base anchor cover and fasteners.
 6. Design information
 - a. IBC 2012 (MOD W/AASHTO), Exposure category C, Risk Category II.
 - b. Wind Velocity: 100 MPH sustained with 130 MPH gust assuming effective panel area (EPA) and weight as required based on radios.
 - c. Pole Top Load: Assume 10 sq ft EPA, minimum.
 - d. One (1) degree of movement maximum at top of pole under wind gust conditions.
 - e. Designed and manufactured by Valmont Industries or equal.
- B. RADIO MODEM
 1. MURS un-licensed frequency radio shall be set for communications over 151 MHZ frequency. The radio and internal modem shall match existing City frequency. Radio Modem shall be NextGen Viper SC+ 140-5018-502, or equal.
- C. ANTENNA

1. Each antenna system shall be furnished and installed complete and functional for the intended use. An antenna system shall include but not be limited to, antenna, antenna pole, mounting hardware, lightning arrestor, and coaxial cables with connectors.
2. Antenna system shall be meet the following Specifications:
 - a. Antenna shall be installed and supported as shown on the Drawings. Support members shall have sufficient strength to withstand local wind conditions and shall be protected from sun exposure and weather damage.
 - b. Support hardware such as clamps, orientation mounts, and offset brackets shall be steel protected with a hot dip galvanized finish or stainless steel. Clamps and mounts shall be heavy duty in order to transfer the full antenna load to the support tower or mast. Bolts and
 - c. The radio antenna shall be 7.1 dB gain, 150-174 Mhz, directional VHF type Yagi, N-female connection, Laird TE Connectivity Model Y1503 or equal.

D. TRANSMISSION CABLE

1. Provide 50 Ohm, 1/2" weatherproof coaxial cable from lightning arrestor to antenna. The coax cable shall have a corrugated outer conductor of copper, copper-clad aluminum inner conductor with foam dielectric. The coax cable shall be jacketed for corrosive environment and ultra-violet exposure. The coax cable shall be capable of a minimum bending radius of 5 inches. The cable shall be installed as one continuous length from the antenna to the lightning arrestor. Antenna cable shall be Andrew Superflex FSJ4-50B, 1/2" coax cable or equal.
2. Cable end "N" connectors shall be furnished for field installation after the cable is run in conduit. Provide straight or right angle connectors as required for the installation as required.
3. Pigtail connector. Provide low loss connection cable for connecting the Radio antenna connection to the lightning arrestor. Pigtail shall have compatible connectors for the radio and lightning arrestor.
4. Furnish an antenna lightning arrestor with "N" connector on the antenna coaxial transmission line. The lightning arrestor shall be grounded to the control panel ground buss by a #8 AWG or larger bonding wire. The lightning arrestor shall be insulated from the backpan. The lightning arrestor shall be a PolyPhaser IS-50NX-C2 or equal.
5. The cable shall be carefully installed to prevent damage to the jacket and routed with a minimum bending radius of 8 inches except where required at the conduit to free-air transition.
6. Provide connector weatherproofing kits for outdoor exposed connectors. All mating connectors that are exposed to weather shall be wrapped with a sealing material designed to protect against water and dirt entry into the connectors.

2.09 SPARE PARTS

- A. The Contractor shall supply all spare parts prior to start of field tests. All parts shall be sealed in plastic bags and delivered to the site in a heavy duty plastic storage bag. Bag shall be clearly labeled with part name & number and the corresponding equipment tagname.
- B. The Contractor shall make available any replacement parts that are not manufacturer's normal stock items for immediate service and repair of all the instrumentation equipment throughout the warranty period.

PART 3 EXECUTION

3.01 CONSTRUCTION METHODS

- A. Equipment shall be assembled and wired by the manufacturer prior to shipment. Field modifications or changes are not allowed without a written "change order" to the Contract. Field changes, however large or small, shall be executed using the components, materials, wiring, labeling, and assembly methods identical to that of the original supplied equipment.
- B. Electrical plugs, receptacles, cords, and connectors required to power or interface the equipment and panels shall be furnished and installed by the Contractor.
- C. Factory as-built Drawings for each custom manufactured control panel or MCC shall be shipped with the equipment and placed inside in waterproof envelopes.

3.02 EQUIPMENT FABRICATION

- A. All electrical equipment, including custom manufactured equipment, shall meet the requirements of Underwriters Laboratories (UL) and bear the appropriate label. Panels shall be affixed with UL label prior to shipment and be built in accordance with the UL guidelines and procedure that corresponds to the UL label. Custom control panels shall bear a UL-508A label for general use, minimum, with additional UL labels as required per intended service.
 - 1. Design and furnish a Low Voltage Limited Energy Circuit for any device(s) not bearing a UL listing or registration that are required to be installed into a UL labeled panel.
 - 2. Revise voltages for any electrical parts and equipment that are specified that do not bear the UL listing or registration.
- B. Panel cutouts for devices (i.e. indicating lights, switches) shall be cut, punched, or drilled and smoothly finished with rounded edges. Exposed metal from cutouts that are made after the final paint finish has been applied shall be touched up with a matching paint prior to installing device.
- C. Equipment doors shall swing freely and close and latch with proper alignment.
- D. Component within the electrical equipment shall be securely mounted on an interior subpanel or backpan and arranged for easy servicing. Mounting bolts and screws shall be front mounted for device removal without special tools or removal of entire mounting panel.
- E. A ground bus shall be provided in each enclosure or cabinet. It shall have provisions for connecting a minimum of ten grounding conductors. Screw type lugs shall be provided for connection of grounding conductors. All grounding conductors shall be sized as shown on plans or in accordance with NEC Table 250 95, whichever is larger.
- F. Bolts and screws for mounting devices on doors shall have a flush head which blends into the device or door surface. No fastening devices shall project through the outer surfaces of equipment.

3.03 WORKMANSHIP

- A. All work in this division shall conform to the codes and standards outlined herein.

- B. Installation shall be performed by qualified personnel providing first class workmanship per Electrical Specifications [Electrical General, Qualifications].
- C. Maintain equipment installed (or to be installed) in new condition. Protect equipment from damage while in Contractor care from dust, water, or mishaps that are typical to construction sites
- D. Confirm that equipment and materials are correct for their intended duty and will be installed per manufacturer guidelines. Equipment and components found to be installed inconsistent with manufacturer guidelines and/or these Specifications will not be acceptable and subject to removal and replacement.
- E. Upon completion of daily work, remove excess materials, scraps, and debris from the work area and from the inside of equipment.
- F. Upon notification, stop work on any portion of the installation that is determined to be non-compliant with contract or being installed by unqualified personnel.
- G. Perform all work to correct improper installations at no additional cost to the owner.
- H. Equipment furnished under this contract or provided to Contractor for installation shall be installed in accordance with manufacturer's instructions, installation calculations, and contract documents.

3.04 EQUIPMENT SHIPMENT AND STORAGE

- A. Shipment -- Any equipment whose destination (jobsite) is more than 25 miles from the factory shall be carefully protected for shipping. All openings shall be protected by plywood securely fastened to the framework of the equipment. Equipment shall be adequately covered during local delivery.
- B. Storage -- From the time of receipt until the equipment is installed and energized, the equipment shall be considered in storage. While in storage, a 120V, 1 phase source of power shall be made available and connected to space heaters in all items of equipment so equipped. Equipment not provided with space heaters shall be provided with a light bulb or electric heater while in storage to prevent moisture condensation. Unless stored indoors, it shall be a least 1 foot above grade covered with at least 2 layers of heavy polyethylene plastic sheets and anchored to prevent damage by high winds. All equipment shall be protected from dust and moisture prior to and during construction.

3.05 DAMAGED PRODUCTS

- A. Damaged products that cannot be repaired to new condition shall be replaced with new products. All equipment and materials shall be in like-new condition at start-up and commissioning.
- B. Any equipment furnished outside of contract to the Contractor shall be repaired or replaced if damaged while in the Contractor's care. The Contractor shall pay for the parts and/or services of the original equipment manufacturer (OEM) to troubleshoot, asses, and repair damaged equipment.
- C. Minor cosmetic damage shall be repaired by spray painting, after properly preparing the surface, all scratches or defects in the finish of the equipment. Only identical paint furnished by the equipment manufacturer shall be used for such purposes.

3.06 INSTALLATION

A. General

1. Install all products per manufacturer's recommendations and the Drawings.
2. Provide all necessary hardware, conduit, wiring, fittings, and devices to connect the electrical equipment provided under other Sections.
3. Protect wiring insulation from wear by installing rubber cushions, bushings, or strip insulation, or by fastening the wiring to a rigid surface with zip ties and anchors.
4. Provide additional devices, wiring, conduits, relays, signal converters, isolators to complete interfaces of the electrical and instrumentation system.
5. Changing normally open contacts to normally closed contacts or vice versa
6. Adding additional relays to provide more contacts as necessary.
7. All programmable devices (not specifically excluded herein) shall be programmed, set-up and tested by the Contractor prior to startup. Programming and set-up parameters shall be adjusted or changed as directed by the Engineer during start-up and throughout the warranty period.
8. Coordinate with the Engineer and setup all alarm, process, and operation setpoints.
9. Keep a copy of the manufacturer's installation instructions on the jobsite available for review at all times prior to and during the installation of the associated equipment.

B. Panels and enclosures:

1. Install panels and enclosures at the location shown on the Plans or approved by the Engineer.
2. Install level and plumb.
3. Seal all enclosure openings to prevent entrance of insects and rodents.
4. Clearance about electrical equipment shall meet the minimum requirements of NEC 110.26

C. Conduits and Ducts:

1. Install all conduits and ducts per Electrical Specifications [Conduit and Boxes] and [Grounding].
2. Minimum wire bending space at terminals and minimum width of wiring gutters shall comply with NEC tables 312-6 (a) & (b).

D. Wiring, Grounding, and Shielding:

1. Observe proper grounding and shielding practices as this application environment is generally noisy. The shield of shielded cables shall be terminated to ground at one end only, the origination end. The shield at the other end shall be encased in an insulated material to isolate it from ground.

E. Cutting and Patching:

1. The Contractor shall do all cutting and patching required for installing his work. Any cutting which may impair the structure shall require prior approval by the Engineer. Cutting and patching shall be done only by skilled labor of the respective trades. All surfaces shall be restored to their original condition after cutting and patching.

F. Cleaning and Touch up:

1. At the completion of the work, all parts of the installation, including all equipment, exposed conduit, and fittings, shall be thoroughly cleaned of grease and metal cuttings. Any discoloration or other damage to parts of the building, the finish, or

the furnishings, due to the Contractor's failure to properly clean the system, shall be repaired by the Contractor.

2. The Contractor shall thoroughly clean any of his exposed work requiring same.
3. Vacuum and clean the inside of all electrical and instrumentation enclosures prior to applying power.
4. The Contractor shall paint scratched or blemished surfaces with the necessary coats of quick drying paint to match existing color, texture and thickness. This shall include all prime painted electrical equipment including but not limited to enclosures, poles, boxes, devices etc.

3.07 APPLICATION OF POWER

- A. The Engineer will direct the energization and de-energization of all existing and new equipment. The Contractor is not authorized to energize or de-energize any equipment unless they have been given written permission to do so or while in the presence of the Engineer.
 1. Any equipment that is under repair, demolition or installation shall be locked off and tagged out of service with Contractor supplied padlocks and tags.
 2. The Contractor is required to comply with NFPA 70E and specifically in regards to safety when working on live equipment. Obtain work permits when needed to do live work.
- B. The Contractor is responsible for grounding of high and medium voltage cabling and/or bus during installation and removal of equipment. The contractor is responsible for complying with all California Electrical Safety Orders (ESO) and Occupational Safety and Health Act (OSHA) safety requirements and procedures while working in or near medium voltage equipment.

3.08 WARRANTY

- A. The Contractor shall warrant all electrical and instrumentation equipment & software for a period of 1 year from date of final acceptance. Standard published warranties of equipment which exceed the preceding specified length of time shall be honored by the manufacturer or supplier.
- B. The Contractor shall have a staff of experienced personnel available to provide on-site warranty service on 2 working days notice during the warranty period. Such personnel shall be capable of fully testing and diagnosing hardware & software and implementing corrective measures.

3.09 FINAL ACCEPTANCE

- A. Final acceptance will be given by the Engineer after the equipment testing is complete, each deficiency has been corrected, final documentation has been provided, and all the requirements of Contract documents have been fulfilled.
- B. At the end of the project, following the completion of the field tests, and prior to final acceptance, the Contractor shall provide the following:
 1. Each "operation and maintenance" manual shall be modified or supplemented to reflect all field changes and as built conditions.
 2. Two (2) disk copies of all final documentation to reflect as-built conditions.

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- C. Keys: Submit two sets of all keys for locks supplied on this project. Wire all keys for each lock securely together. Tag and plainly mark with lock number or equipment identification, and indicate physical location, such as panel or switch number.

END OF SECTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Labor, materials, equipment, tools, safety gear, test equipment, incidentals, services, and transportation for a complete electro-mechanical installation as shown on the Drawings, included in these Specifications, or as can be reasonably implied from project descriptions.
- B. The scope of work includes:
 - 1. Furnish and install conduits, wireways, raceways, cable trays, junction boxes, pull boxes, and associated hardware. Provide conduit, fittings, hardware, hangars, mounting channel, and other parts for a complete raceway installation.
 - 2. Furnish and install grounding system required by drawings, or if not shown or defined, as required by Article 250 of the NEC.
 - 3. Installations shall be designed and installed with components meeting the NEMA area designation.
- C. Work includes that specified in Electrical Specifications [Electrical General].

1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Electrical Specifications [Low Voltage Wire & Data Cable]
- C. Electrical Specifications [Grounding]
- D. Project Drawings

1.03 QUALIFICATIONS

- A. Material furnished under this specification shall be installed by qualified installers meeting requirements specified in Electrical Specifications [Electrical General, Qualifications].

1.04 SUBMITTAL REQUIREMENTS

- A. Provide submittals and drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].

PART 2 PRODUCTS

2.01 CONDUIT, RACEWAYS AND WIREWAYS

- A. GENERAL - Conduit, raceways, and wireways, wiring methods, materials, installation shall meet all requirements of the NEC, be UL labeled for the application, and meet the minimum following specifications.
 - 1. All wiring shall be installed in conduits, raceways, or wireways when interconnecting equipment and devices.
 - a. The minimum size conduit shall be 3/4-inch unless indicated otherwise on the Drawings or for special connections to equipment.

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- b. Provide cords and cord seals for devices or instrumentation requiring waterproof seal to maintain NEMA 4 or 4X ratings. Example devices include lighting and pipe mounted instruments that are located below grade.
- 2. Conduits may connect into junction boxes or wireways as shown in the drawings or as requested by Contractor and approved by Engineer. Junction boxes (circle with J in drawings) can be as simple as a condulet or JIC box, or larger box as determined by contractor and needed for the installation. Drawing may or may not depict junction box requirements that may be required by code. Wireways or junction boxes shall be rated for area (as noted in the Drawings), or furnish minimum NEMA 4 if not noted.
- 3. The Contractor shall use conduit material types (SPEC per conduit schedule) as defined below or as otherwise shown in the contract drawings or as specifically called out in the conduit schedule.
 - a. Non-exposed underground portions of conduit run shall be PVC-40 for all signals and voltages unless otherwise shown in the conduit schedule.
 - b. Exposed conduit material (not underground and beyond transition) shall be per the following table unless specifically noted otherwise in the plan drawings. The conduit schedule denotes the conduit type for non-exposed (under-ground, in-concrete, etc.) and does not apply or coordinate with this table. Exposed condulets, elbows, fittings, device boxes, and hardware shall be of the same material and finish as the adjacent conduit.

<u>Location</u>	<u>Material</u>
NEMA 1 or 12	Galvanized rigid steel (GRS)
NEMA 3R	Galvanized rigid steel (GRS)
NEMA 4	PVC-Coated Steel (GRS-PVC)
NEMA4X	PVC-Coated Steel (GRS-PVC)
Class 1 Div 1 or 2 hazardous	PVC-Coated Steel (GRS-PVC)

- 4. Conduit stubs and transitions:
 - a. Conduit transitions shall be GRS-PVC for 6" on either side of the transition point (minimum) or as shown in drawing details. Conduit transition is defined as conduit sections emerging from or through concrete or earth or from below to above grade or through walls or vaults, non-exposed to exposed.
 - b. Beneath pad mounted electrical equipment, where not exposed, shall be installed or trimmed to 2" or less above slab and have bushing or end bell installed. Overall height of conduit entering into the base of equipment shall be enough for bushings/bells to be installed but be high enough for conduit tags to be installed.
 - c. Uniform in height for each panel or section. Conduits end bushings/bells shall not vary in height above slab more than 1/2" from lowest to highest.
 - d. Conduits shall be spaced apart such that bushings and end bells may be installed without interfering with the adjacent conduits.
 - e. Transitions to PVC shall include PVC coated locknuts to shield exposed steel pipe threads.
 - f. Through walls – shall protrude approximately 2" and include end bell or bushing. Pack space around conduit with non-shrink grout if the thru-hole was core drilled.

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- g. From hazardous locations – shall include seal off and/or conduit cable seals as required per NEC.
 - h. Conduits for future use shall be capped with coupling and plug. Identify each end with conduit labels.
 - i. Existing conduits that are no longer able to be used due to removal of equipment or shown demolished, shall have flexible conduit removed, wires removed or pulled back to the nearest pullbox, coiled and labeled at each end. Disconnect wires at each end.
5. Conduit Tags
- a. All conduits listed in the “Conduit and Wire Routing Schedule” shall have conduit tags at both ends of each conduit run with tag number from schedule identified. This shall include ends within underground pull boxes.
 - b. All conduits shall have temporary tags during construction. Temporary tags may be made from duct tape with hand written ink marking or suitable equivalent. Temporary tags shall be removed by Contractor at time of installation of permanent tags.
 - c. Tag material shall be rigid laminated red plastic with white lettering. The size of the tag shall be ¼” thick by 1” round or ¾” x 1” rectangle minimum.
 - d. Letter height shall be 3/8” minimum. Engrave the tags with the conduit number or acronym. Labeling shall be neatly installed for visibility and shall be clearly legible. Securely fasten tags in place using 20ga stainless steel tie wire through a pilot hole on the tag.
 - e. Conduit tags shall be Custom manufactured per specification.
6. Supports
- a. Cross section of a single channel shall be 1-5/8" x 1-5/8" and cross-section of a double channel shall be 1-5/8" x 3-1/4". The channel wall thickness shall be 12 gauge as applicable.
 - b. One-Hole clamps shall be intended for pipe mounting on support channels and equipped with clamp-backs. The clamps shall be Efcor, Thomas and Betts, Appleton or equal
 - c. Spacers, provided to support underground conduits in concrete encasements, shall be plastic. The spacers shall be Carlon, Johns-Manville, Underground Products or equal
 - d. Anchors shall be expansion type for securing equipment to concrete foundations, floors and walls. Anchors shall have length identification mark on the exposed end of the bolt. Provide Hilti Kwik Bolt 3, or equal.
 - e. Stanchions shall be provided as needed to mount equipment and electrical components. Stanchions shall be shop fabricated from welded 4" c-channel, 12" x 12" x ¼" steel base plate, coated with a rust inhibiting primer and top coat of gray polyurethane gloss paint. Attach equipment to the stanchion direct or on a ¼" aluminum sheet sized for the equipment supported.
 - f. Conduit Hangers shall be trapeze construction, with double channel, 3/8-inch rods and nuts. Suspend from suitable structural support.

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- g. Support material and finish shall be per the following table unless otherwise noted in the drawings. Brackets, fittings and hardware shall be of the same material and finish.

<u>Location</u>	<u>Material</u>
Indoors NEMA 12	Galvanized steel
Outdoors NEMA 3R	Galvanized steel
Outdoors NEMA 4	Stainless Steel type 316
Corrosive areas NEMA4X	PVC bonded, 40 mil, factory applied

- h. Equipment mounting racks shall be designed by installer for rigid equipment and conduit mounting. Racks shall be bolted or welded construction and sized for equipment or as shown on the drawings.
- i. Strut channels shall be used for mounting equipment to walls and for supporting conduit runs. Double strut channel type shall be used for fabricating equipment mounting racks as required and/or as detailed on the drawings. Add additional supports to rigid mounting locations as needed to prevent wobbling and to meet seismic requirements. All field cut surfaces of the strut channels shall be deburred and coated to prevent rust.

B. Galvanized Rigid Steel Conduit - (GRS)

1. Manufactured from high-strength steel and hot dipped zinc galvanized inside and out. Conduit and fittings shall meet UL 514B, UL 6, and conform to NEMA RN 2. Conduit shall be capable of being used as an equipment grounding conductor per NEC 250.
2. Provide galvanized rigid steel factory sweeps and elbows for 90 degree transitions.
3. Cast fittings and device boxes shall be malleable iron or aluminum. Appleton type FS/FD or equal.
4. In hazardous locations, fittings shall meet and be listed UL 886.
5. All fittings, hubs, couplings, pulling elbows and connectors shall be threaded-type. Set-screw type and compression-type are not acceptable. All thread conduit is not allowed over 1/2" exposed length. Cover plates shall be cast iron with sealing gasket in NEMA 3R locations.
6. Conduits entering enclosures shall be fitted with insulated grounding bushing; O-Z "HBLG", Appleton "GIB", or approved equal. All grounding bushings shall be tied to the grounding system with properly sized bonding conductors per the NEC code.
7. Combination expansion-deflection fittings installed exposed shall be Type XD as manufactured by Crouse-Hinds Co.; Type DX as manufactured by O.Z. Gedney Co.; Type DF as manufactured by Appleton Electric Co., or equal

C. Galvanized Rigid and Coated Steel Conduit (GRS-PVC)

1. Galvanized Rigid Steel conduit with a 40-mil thick polyvinylchloride exterior coating and a 2-mil urethane interior coating meeting NEMA RN-1, UL-6 and ETL PVC-001. The bond of the PVC to the zinc coated pipe must be stronger than the tensile strength of the PVC.
2. Provide PVC coated galvanized rigid steel factory sweeps and elbows for 90 degree transitions.
3. Cast fittings and device boxes shall be malleable iron or aluminum with a 40-mil thick PVC coating meeting the same
4. In hazardous locations, fittings shall meet and be listed UL 886.

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5. Provide PVC coated threaded-type fittings, hubs, pulling elbows, couplings, and connectors; set-screw type and compression-type are not acceptable. Form 8 conduit fittings, ½” through 4”, must have a tongue-in-groove gasket to effectively seal out the corrosive elements. Covers shall be supplied with plastic encapsulated stainless steel cover screws. Form 8 fittings shall be UL and type 4X and IP69 listed.
 6. A “PVC Coated Sealing Locknut” shall be used on all exposed male threads transitioning into female NPT threads which do not have sealing sleeves, including transitions from PVC couplings/female adapters to PVC Coated GRC elbows in direct burial applications. “PVC Coated Sealing Locknuts” are not to be used in place of a myers hub
 7. A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.
 8. All junction and metal pull boxes shall be galvanized with exterior surfaces PVC coated to 40 mils thickness.
 9. Unistrut, strut clamps, pipe straps, and clamp back spacers, shall have 40 mil thick PVC coating. All mounting anchors shall be stainless steel.
 10. Conduits entering enclosures shall be fitted with insulated grounding bushing. All grounding bushings shall be tied to the grounding system with properly sized bonding conductors per the NEC code.
 11. Installers of PVC Coated Conduit must be certified by the manufacturer and be able to present a valid, unexpired certified installer card.
 12. GRS-PVC conduit to be Robroy Plasti-bond, Perma-Cote, KorKap, T&B OCAL or equal.
- D. PVC Conduit, Schedule 40 or 80 (PVC-40, PVC-80)
1. Shall be high impact schedule 40 or 80 polyvinylchloride suitable for use underground, direct burial and for use with 90 C wires, and shall conform to UL 651. Shall be UL listed and labeled for "direct" burial.
 2. A copper bonding conductor shall be pulled in each raceway and bonded to equipment at each end with approved lugs.
 3. Each underground run shall be placed in a trench with a five (5) inch sand bed evenly compacted on all sides, top and bottom unless otherwise noted.
 4. Elbows, and risers shall be per exposed conduit transition detail. PVC conduit is not allowed above ground except where specifically called out on the Drawings.
 5. PVC fittings shall have solvent-weld-type conduit connections. Fittings and device boxes shall be PVC with factory fabricated conduit connections. Provide Carlon or equal.
 6. Conduits entering enclosures shall be fitted with a glued male adapter, lock ring and bushing to prevent wire chafing. Conduits entering panels through concrete to an open bottom or entering a pull box shall have a glued end bell fitting.
 7. PVC conduit shall be stored on a flat surface and shielded from the sun.
- E. Liquid Tight Flexible Non-metallic Conduit (up to 2”) - (FLEX)
1. Liquid tight flexible Nonmetallic Conduit shall be constructed of flexible PVC and have a smooth inner surface with integral crush resistant reinforcement within the conduit and be designated as a Type LFNC-B (for FNMC-B).
 2. Liquid tight Flexible Nonmetallic Conduit shall be sunlight, oil, and flame resistant and approved for the installation of electrical conductors in indoor and outdoor applications.
 3. Liquid tight Flexible Nonmetallic Conduit shall be listed to UL standard UL1660.

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4. Liquid tight flexible non-metallic conduit shall be installed in accordance with Article 351, Part B of the National Electrical Code (NEC) and other applicable sections of the NEC and/or local electrical codes.
 5. Liquid tight Fittings shall be listed for the use with Liquid tight Flexible Nonmetallic Conduit and shall be marked LFNC-B (FNMC-B).
 6. Flexible Non-Metallic Conduit shall be Carlon Carflex or equal.
- F. Liquid Tight Flexible Metal Conduit (above 2-1/2") - (FLEX)
1. Liquid Tight Flexible Metal conduit shall be moisture and oil-proof with PVC jacket extruded over a galvanized flexible steel conduit.
 2. Liquid Tight Flexible Metallic Conduit shall be sunlight, oil, and flame resistant and approved for the installation of electrical conductors in indoor and outdoor applications.
 3. Liquid Tight Flexible Nonmetallic Conduit shall be listed to UL standard UL 360.
 4. Liquid Tight flexible metallic conduit shall be installed in accordance with Article 351, Part B of the National Electrical Code (NEC) and other applicable sections of the NEC and/or local electrical codes.
 5. Liquid Tight Fittings shall be listed for the use with Liquid tight Flexible Metallic Conduit and conform to UL514B.
 - a. Outdoors when extension of GRS-PVC: PVC coated galvanized steel with insulated bushings.
 - b. Outdoors when extension of GRS: Galvanized steel with insulated bushings.
 - c. Indoors or outdoors when extension of stainless steel: 316 stainless steel with sealing ring and insulated bushing.
 - d. Indoors: Galvanized steel with insulated bushings.
 6. Flexible Metallic Conduit shall be Amer-Tite type GP or equal.

2.02 DEVICE BOXES

A. BOXES

1. Device boxes shall be of zinc-galvanized malleable iron or cast aluminum with shape and size best suited for the particular application, rated for the location installed, and shall be supported directly to structure by means of screws, anchors, or bolts.
2. Box dimensions shall be in accordance with size, quantity of conductors, and conduit clearances per NEC articles 314 requirements.
3. Boxes exposed to the weather or in moist locations shall be weatherproof (WP) by means of gasketing under a weatherproof cover.
4. Boxes connected to GRS-PVC conduit runs shall be PVC coated with 40 mil coating.

B. DEVICE PLATES and COVERS

1. Indoor general purpose device plates and covers shall be stainless steel. Plates or covers shall be attached with stainless steel screws. An engraved plastic label denoting circuit breaker number and panelboard name shall be affixed to each cover with #4 stainless steel screws.
2. Weatherproof switch, outlet, and receptacle boxes shall be fitted with gasketed covers rated for wet locations. Each access cover shall have a padlockable cover to maintain security and weatherproof integrity even when a plug is connected to the receptacle. Screws and hinge springs shall be stainless steel. Weatherproof access covers shall be Leviton 5977-CL, Cooper 4966, or equal.

2.03 PULL BOXES

A. JUNCTION BOXES

1. Where required for best installation or where specifically called out in the Drawings, junction boxes shall have JIC type construction with hinged door, NEMA 4X rating, manufactured of type 304 stainless steel or as otherwise shown. Door shall be fastened with clamps and stainless steel screws. No devices, screws, rivets, or bolts shall protrude through the exterior surface unless specifically shown on the Drawings. Boxes shall be Hoffman, Circle AW, or equal.

B. UNDERGROUND BOXES

1. Underground pull boxes shall be prefabricated “Christy Box” size and type as noted in the Drawings or equal. Size shall be as shown or dimensioned on the Drawings. Provide larger boxes as needed to meet code or as determined in field to allow for adequate pull area at Contractor discretion. Extension sections shall be provided as necessary to reach the depth of underground conduits with maximum depth of 48”. All boxes shall have galvanized steel hold down bolts and hardware. Boxes shall be H/20 loading rated and have traffic rated covers. Steel covers or lids shall be galvanized and grounded with bonding jumper to the local grounding circuit per NEC. Pull box covers shall be labeled electrical, signal, utility, and telephone, whichever applies. Pull boxes shall be Christy Concrete Products, Brooks or equal.

C. Pull Box and Vault Identification

1. Engrave or bead weld box covers with minimum thickness of ¼” x 1” lettering with pullbox name (i.e. PBX-XXX) and purpose (electrical, signal, fiber, telephone, etc.). Provide an additional identifier “high voltage” for boxes with 600 volts or higher.
2. Utility pull boxes shall be labeled per Utility Company standards.

PART 3 EXECUTION

3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

3.02 INSTALLATION

A. System:

1. Install all products per Electrical Specifications [Electrical General, Installation].

B. Rigid Conduits and Ducts:

1. Exposed conduits shall be neatly arranged with runs perpendicular or level and parallel to walls. Bends shall be concentric.
2. Except as expressly indicated or approved, all conduits shall be surface mount on block walls, concealed behind gypsum walls, and buried to required depth below floor slabs.
3. Pipe threads shall be treated with conductive thread compound.
4. Installation of the GRS-PVC conduits must be in accordance with the manufacturer’s installation procedures using recommended tools.

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- a. Apply touch up compound at each fitting sealing sleeve edge to improve watertight seal.
 - b. To ensure compliance, the installer(s) must be “manufacturer certified” before installation can proceed.
 - c. Certification available by contacting manufacturer’s representative and attending a brief instructional course. Valid and unexpired certification card shall be available for review per installer.
5. Repair GRS-PVC coating utilizing a touch-up compound as provided by the manufacturer of the conduit of the same material as the coating. Overlap beyond the damaged area to cover the PVC coating. Contact from touchup compound to PVC is required to maintain integrity. The entire conduit shall be replaced if the repair exceeds 1” combined length.
 6. A maximum of three equivalent 90 degree elbows are allowed in any continuous run. Install pull boxes where required to limit bends in conduit runs to not more than 270 degrees or where pulling tension would exceed the maximum allowable for the cable.
 7. Route all above grade conduits parallel or perpendicular to structure lines and/or piping. Conduits installed above grade shall be braced in place with stanchions. Expansion joints shall be installed every 100 feet. Bends shall be concentric.
 - a. Combination expansion-deflection fittings installed exposed shall be Type XD as manufactured by Crouse-Hinds Co.; Type DX as manufactured by O.Z. Gedney Co.; Type DF as manufactured by Appleton Electric Co., or equal
 8. Care shall be exercised to avoid interference with the work of other trades. This work shall be planned and coordinated with the other trades to prevent such interference. Process Pipe, mechanical and HVAC shall have precedence over conduits for routing and space requirements.
 9. Seal each bottom entrance conduit into the MCC and other electrical enclosures with plugging compound sealant to prevent the entrance of gasses, insects and rodents. Plugging compound sealant shall be Gardner Bender Duct Seal or equal.
 10. Seal conduits from wetwells within underground pullboxes with conduit cable seals. Furnish Roxtec RS UG, Crouse Hinds, or equal.
 11. Exposed conduit stubs for future use shall be capped with coupling and plugged. Drill hole in plug for pull rope as necessary.
 12. Explosion proof seal-off fittings shall be provided on all conduits that enter or leave hazardous areas per requirements of the National Electrical Code, Chapter 5 and UL 886. The seal-off fitting shall prevent hazardous gases and/or flames from passing from one type area to another through the conduit system. Ceramic or other non-asbestos fiber material and sealing compound shall be placed in the fitting to complete the seal.
 13. Hazardous location conduit outlet boxes shall be used in hazardous locations for change in direction, access to conductors and as pull and splice boxes.
 14. All spare conduits shall have 1/8" nylon pull ropes installed.
- C. Flexible Conduit and Cords
1. Final connections to vibrating equipment such as motors, heaters and fans shall be made with liquid tight flexible conduit.
 2. Flexible conduit lengths shall not be greater than 36 inches for sizes up to 2 ½” and 48 inches for 3” and larger conduit.
 3. Flexible conduit shall include a ground conductor for equipment bonding in circuits over 30 VDC or as shown in the conduit schedule.
 4. Flexible conduit shall only be installed in exposed or accessible locations.

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5. Where equipment is cord connected, submersible rated, and conduit connections are not possible without modification, devices and equipment may be free-air cord connected in lieu of flexible conduit. Connection to adjacent rigid conduit shall be through liquid-tight cord connector fitting specifically designed for the purpose and sized appropriately for the cord. Cord connectors shall be rated similar to the adjacent conduit they are connected to: Stainless steel, galvanized or plastic.
- D. Excavation and Back Filling:
1. Trenches for conduit below floor slabs and other underground electrical conduit shall be excavated to the required depths per utility requirements or specific detail. Conduits under floor slabs shall have minimum trench depth to contain bends without any portion of the radius visible at finished grade.
 2. Underground conduits outside of structures, excluding utility conduits, shall have a minimum cover of 24 inches except under roadways where minimum cover shall be 30 inches or as otherwise shown in the Contract Drawings. Back filling shall be done only after conduits have been inspected. Excavation and back fill of conduits shall conform to the requirements of other applicable Specifications sections unless modified on plans, and to other entities (Utilities, etc.) as required.
 3. Install spacers to support underground conduits. Horizontal and vertical separation shall be maintained by plastic spacers set every four feet. Spacers shall be Carlon Snap-Loc or equal.
 4. At all times during the installation of the electrical system, the Contractor shall provide barricades, fences, guard rails, etc., to safeguard all personnel, including small children, from excavated trenches.
- E. Underground pullboxes:
1. Pullboxes shall be located in areas that will experience the least traffic loading and in the general vicinity as shown in the Drawings. Boxes in pavement shall be set at final grade and boxes in planter areas shall be set 1" above final grade. Boxes shall not be buried by landscape material.
 2. Steel pull box lids shall be grounded per NEC 250.4(A)(5) and 314.4.
 3. Boxes shall be set on compacted base and base rock to minimize settling of the box over time. If the box is located in a paved traffic area, a 6" x 6" concrete ring shall be poured around the box below the pavement.
- F. Device Mounting Heights:
1. Mounting heights of fixtures and devices shall be as follows unless otherwise indicated or when height has to be adjusted to be over or under counter tops.

a.	Wall switches	=>	48 inches
b.	Convenience outlets	=>	18 inches
c.	Telephone outlets	=>	18 inches
d.	Bracket fixtures	=>	7 feet 6 inches
- G. Cutting, Coring, Patching and Repairing:
1. The Contractor shall do all cutting and patching required to install his work. Any cutting which may impair the structure will require prior approval. Cutting and patching shall be done only by skilled labor of the respective trades. Where it is becomes necessary to cut into existing work for the purpose of making electrical installations, locate existing post tension cables, rebar and electrical services prior to core drilling using ground penetrating radar or similar technologies. All surfaces shall be restored to their original condition after cutting and patching.

3.03 FIELD ASSISTANCE

- A. General: Provide all equipment and supplies necessary to perform all testing. The Owner Representative shall have the option to witness and participate in the on-site tests performed by the installer.
- B. Per Electrical Specifications [Factory and Field Testing].

3.04 WARRANTY

- A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

END OF SECTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Labor, materials, equipment, tools, safety gear, test equipment, incidentals, services, and transportation for a complete electro-mechanical installation as shown on the Drawings, included in these Specifications, or as can be reasonably implied from project descriptions.
- B. The scope of work includes:
 - 1. Furnish and install wire, splices, lugs, or other miscellaneous devices as defined in this specification.
 - 2. End to end wiring and terminations for each system, device, instrument, and piece of equipment shown in the Drawings as new, or rehabilitated, or reconnected.
 - 3. Testing of conductors and completed wired systems.
 - 4. Installations shall be designed and installed with components meeting the NEMA area designation.
- C. Work includes that specified in Electrical Specifications [Electrical General].

1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Electrical Specifications [Conduit and Boxes]
- C. Electrical Specifications [Grounding]
- D. Project Drawings

1.03 QUALIFICATIONS

- A. Material furnished under this specification shall be installed by qualified installers meeting requirements specified in Electrical Specifications [Electrical General, Qualifications].

1.04 SUBMITTALS AND DRAWINGS

- A. Provide submittals and drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].

PART 2 PRODUCTS

2.01 WIRING AND ELECTRICAL DEVICES

- A. GENERAL
 - 1. General
 - a. Provide wiring and electrical devices specified herein and install field and internal panel wiring as shown on the Contract Drawings.
 - b. This section applies to all wires or conductors used internal (non-field) to electrical equipment or external for field wiring.

- c. Field wire quantity and size shall be per "Conduit and Wire Routing Schedule."
 - 2. Analog Signals
 - a. Analog signal transmission between electric or electronic instruments shall be 4-20 milliamperes and shall operate at 24 volts DC unless otherwise specified. Milliampere signals shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.
 - b. Provide powered current isolators wherever the loops' load resistance exceeds the originating current signal transmitter's rating. Associated shunt resistors shall be located on rail-mounted terminal blocks. Exposed resistor leads shall be insulated with heat-shrink tubing.
- B. LOW VOLTAGE WIRE AND CABLE (through 600V except instrument signals)
 - 1. General: Low voltage conductors shall be used for power, control, lighting and miscellaneous circuits. This Section applies to all wires or conductors used internal for all electrical equipment or external for field wiring. Wire shall be new, plainly marked with UL label, gauge, voltage, type of insulation, and manufacturer's name.
 - a. Conductors shall be copper with a minimum of 98% conductivity.
 - b. Control and instrument wiring shall have tinned copper conductors.
 - c. Class C stranding. Solid conductors may be used for lighting and receptacle circuits.
 - d. Wire shall be rated 600 volt (min).
 - e. Size all conductors per NEC minimum or as shown on the drawings.
 - 1) Minimum #12 AWG for wires used in power transmission circuits or as defined on the drawings.
 - 2) Minimum #14 AWG for wires used in signal transmission circuits or as defined on the drawings.
 - 2. Wire colors and sizes shall not change within the circuit.
 - 3. Wire shall be properly fused or breaker protected at or below the maximum amperage rating allowed by the NEC.
 - 4. Control and Power Wiring:
 - a. Field wire in conduit:
 - 1) Type XHHW-2, XLPE insulation, rated 90 °C in wet or dry locations, oil resistant.
 - a) Use for power circuits carrying voltages higher than 200 volts phase to ground.
 - 2) Type THHN / THWN, PVC with nylon jacket insulation, rated 90 °C in dry locations and 75 °C in wet locations, oil resistant, UL83.
 - a) Use for power circuits with voltages below 200 volts phase to ground, or control circuits.
 - 3) Minimum #12 AWG for wires used in power transmission circuits or as defined on the drawings.
 - 4) Minimum #14 AWG for wires used in signal transmission circuits or as defined on the drawings.
 - b. Field wire in tray (Tray Cable type TC):
 - 1) Individual cables - Insulation type THHN/THWN, rated 90 °C in dry locations and 75 °C in wet locations, oil resistant, UL83.
 - 2) 3 or more conductor plus ground wire in a single cable.
 - 3) UL Listed as sunlight resistant, direct burial, and open wiring.
 - 4) Conductor sizing per ICEA Publication P-54-440 for cable tray and ICEA P-46-426 for conduit

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- 5) Minimum #12 AWG for wires used in power transmission circuits or as defined on the drawings.
 - 6) Minimum #14 AWG for wires used in signal or control transmission circuits or as defined on the drawings.
 - c. Power cord
 - 1) Flexible wire cord shall be type SOW, SOOW, or G and be provided in 2, 3, or 4 conductor plus ground as required for connected load.
 - 2) EPR insulation, 90 deg C rating, oil and abrasion resistant., overall jacket plus individual conductor jackets. 600V rated
 - 3) Conductors shall be stranded copper.
 - 4) Cord shall be installed with cord grips on each end where it enters termination enclosures.
 - d. Nonfield control panel or factory installed equipment internal wiring:
 - 1) Insulation - Type MTW, NFPA standard 79, UL 1063 with tinned copper.
 - 2) Minimum #14 AWG for wires used for individual conductor circuits 100 volts and above.
 - 3) Minimum #18 AWG for wires used for individual conductor circuits below 100 volts.
5. Instrument wiring:
- a. Field: Instrument cables shall have 600V tray cable rated insulation and 100% individual shielded twisted pair #18 (or #16 conductors) with drain wire. Single twisted shielded pair (TSPR) cables shall be Belden 9341 (or 9342), or approved equal. Three wire twisted shielded cables (#18 TS3W) shall be Belden 1119A or equal. See drawings for cable size required.
 - b. Non-Field: Instrument cables shall have 300V rated insulation and 100% individual shielded twisted pair #18 conductors with drain wire. Single twisted shielded pair (TSPR.) cables shall be Belden 8760, or approved equal. Three wire shielded cable shall be Belden 8770 or equal.
 - c. Field multi-pair instrument cable as required per conduit schedule shall have 300V rated insulation and 100% individual shielded twisted pair #18 conductors with drain wire. Multiple twisted shielded pair (T.S.PR.) cables shall be Belden 9773 thru 9777, or equal.
 - d. Multi-pair cable is not allowed (unless specifically called out in conduit schedule or on plans) for use in field or non-field applications. One T.S.PR cable is required for each signal.
6. Manufacturer Supplied Cables
- a. Cables and wiring for special systems provided by the manufacturer with the equipment shall be installed per the manufacturer's recommendations.
7. Data Cable
- a. Data network category 6 cable (indoor) shall consist of 4 pair unshielded twisted pair #23 awg solid copper conductors. The cable shall be rated by IEEE for service intended – plenum and dry.
 - 1) Cable: IEEE Category 6, various manufacturers.
 - 2) Connectors: Standard RJ-45 with boot.
 - b. Data network cable (outdoor) shall consist of 4 pair foil and braid shielded twisted pair #24 awg solid copper conductors with anti-crosstalk divider, and drain wire. Rated Level 2 Category 6+ Outdoor Carrier by IEEE for use in plenum, conduit, wet or dry.
 - 1) Cable: IEEE Category 6, Belden 2149a, or equal
 - 2) Connectors: Grounded RJ-45 with drain wire crimp.

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- 8. Temporary motor or panel hook-up
 - a. Temporary cable may be cord without conduit or PVC conduit with wiring. In either case, the cabling must be protected from damage during construction. Sections may be located out of harms way, buried, or sleeved in steel conduit as needed.
 - b. Power Circuits: Provide 2, 3, or 4 conductor plus ground power supply cable(s) for temporary pump connections or electrical power circuits. Cables shall be sized for breaker rating amperage, (minimum).
 - c. Provide multi-conductor (TC) cables for digital control circuits. Provide quantity of conductors as needed.
 - d. Provide instrument wiring for 4-20 ma instrumentation.
 - e. Voltage drop in power circuits shall not exceed 15% during motor start and 5% during operation.

C. COLOR CODE

- 1. All wires #8 and below shall have wire insulation the color specified. Wires #6 and larger may be black with color electrical tape at termination points.
- 2. No other colors shall be used without prior approval.
- 3. Color code color code of all wire shall conform with the following table:

WIRE COLOR CODE TABLE

Description	Phase/Code Letter	Field wire or tape color	Non-Field Wire Color
480V, 3 Ph	A	Brown	Brown
	B	Orange	Orange
	C	Yellow	Yellow
240V or 208V, 3 Ph	A	Black	-
	B	Red (Orange if high leg)	-
	C	Blue	-
	Neutral	White	White
240 / 120 V, 1 Ph	L1	Black	Black
	L2	Red	-
24V Positive	24+	Blue	Pink
24V Negative	24-	Gray	Gray
12V Positive	12+	Blue	Red
12V Negative	12-	Black	Black
AC Control		Red	Red (Yellow for foreign circuits)
DC Control		Blue	Blue
Ground	G	Green	Green
Shielded Pair	+	Red, Clear, or White	Clear or White
	-	Black	Black

2.02 WIRE MARKING

- A. All panel, enclosure and field wiring shall have wire labels on both ends of each wire. Labeling shall be neatly installed for visibility and shall be clearly legible. Each conductor of instrument shielded signal wiring shall be labeled. Wire labels shall be machine printed with on white heat shrinkable tubing. Each label shall fit a minimum 23 characters, 3/16" in height before shrink. Tubing shall be oversized for the wire and shrunk into place using an electric heat gun. The "shrunk" label shall have just enough give to allow the label to be rotated. Hand lettered wire labels are not acceptable and shall be replaced at the Contractor's expense. Provide Brady "PermaSleeve" or equal.
 - 1. Node Style Wire Identification All wires that are electrically the same (connected to common termination points) and do not pass through a contact or other switching device shall have the same wire identification. The wire labeling code for each end of the same wire shall be identical.
 - a. The wire identification code for internal panel wiring shall be the number/letter as designated on the Drawing elementary and/or approved shop drawings.
 - b. Wire labeling for field wiring shall contain the field equipment name/tag as a prefix and the purpose. (I.E. FIT071-+ and FIT071-- or P10-124) where + or 124 are the field device terminal block name or purpose. The hierarchy of prefix label names is 1) Instrument Tag, 2) Electrical panel or equipment name, and 3) Equipment name. Therefore, wires from MCC50 P10 cubicle to PLC10 will be labeled MCC50-P10-xx where xx is the terminal number or the purpose. Wires from field pressure switch PSH10 to MCC50 P10 will be labeled PSH-10-xx where xx is the PSH terminal block name. See example PLC I/O wiring diagram.
 - c. Wire labels shall be per control panel submittal and/or interconnection submittal drawings using rules described above – Wire labels must be documented prior to printing and before they are applied. Abbreviations may be used in the wire label as long as they are consistent and understandable.
 - d. Wire labels for lighting and receptacle circuits shall consist of the panel board and circuit number and a unique node number. (I.E. LP#3-A, LP#3-B, LP#3-N)
 - e. Wire labels may be omitted on "neutral jumpers" less than 8" in length.
 - f. Wire labelling shall be documented and revised on drawings to as-built conditions.

2.03 ELECTRICAL TAPE / SHRINKABLE INSULATORS

- A. Vinyl tape shall be 7 mil, 600 volt rated, flame retardant, hot and cold weather resistant conforming to UL510. Provide 3M Scotch Super 33+ vinyl tape or equal.
 - 1. Vinyl tape for color coding shall be 7 mil, 3/4" width, vinyl tape conforming to UL 510. Provide 3M Scotch 35 vinyl tape or equal.
- B. Rubber Tape: EPR rubber, 90 deg C continuous rated. Provide 3M 130C rubber tape or equal.
- C. Varnished Cambric Tape: Adhesive backed, 7 mil, bias cut cotton tape, coated with yellow insulating varnish. Provide 3M Scotch 2510 or equal.
- D. Shrinkable insulators shall be heat shrinkable, polyolefin thick wall sleeves, end caps and cable repair sleeves are designed for use in splicing, sealing and re-jacketing of direct bury secondary cables. The insulators shall comply with UL 486D and be rated up to

1000 Volts. They shall provide long-term reliable performance overhead, underground or submerged with mechanical and environmental protection. Shrinkable insulators shall be 3M ITCSN or 3M IMCSN per manufacturer instructions for the application or equal.

PART 3 EXECUTION

3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].
- B. Perform work to remedy non-compliant installations after inspection.
- C. Upon notification, stop work on any portion of the installation that is determined to be substandard or being installed by unqualified personnel.

3.02 FABRICATION AND INSTALLATION

- A. System:
 - 1. Install all products specified in Electrical Specifications [Electrical General, Installation].
 - 2. Panels shall be completely factory wired and tested before shipment.
 - 3. All spare PLC input / output points shall be wired to terminal blocks.
 - 4. A minimum of 20% spare unwired terminals shall be provided in each panel.
- B. Wiring Methods:
 - 1. Wiring Separation: Wires carrying 100 volts and above shall be physically separated from lower voltage wiring by using separate bundles or wire ways with sufficient distance to minimize the introduction of noise, crossing only at 90 degree angles.
 - 2. Harness: All wiring shall be neatly bundled and laced with plastic tie wraps, anchored in place by screw attached retainer. Where space is available, wiring shall be run in slotted plastic wireways with dust covers. Wireways shall be sized such that the wire fill does not exceed 60%. Tie wraps shall be T&B TY RAP or equal.
 - 3. Retainers: Wireways, retainers, and other devices shall be screw mounted with round head 316 stainless steel screws or mechanically mounted by push in or snap in attachments. Glue or sticky back attachment of any type or style shall not be used. Retainers shall be T&B TC series or equal.
 - 4. Hinge Loops: Where wiring crosses hinged surfaces, provide a "U" shaped hinge loop protected by clear nylon spiral wrap. The hinge loop shall be of sufficient length to permit opening and closing the door without stressing any of the terminations or connections. Spiral wrap shall be Graybar T25N or equal.
 - 5. Routing: Wires and cable shall be routed such as to maintain separation between 100 Volt or higher from 100 volt or lower wiring being run in the same duct or bundle. Wires and cables shall have sufficient length to allow slack and to avoid any strain or tension in the wire or cable.
 - a. Wires shall be routed in slotted plastic wireways with snap covers. Wires carrying 120 VAC shall be separated as much as possible from other wires and signal cables, and shall be routed only in ducts for 120 VAC. If the power wiring has to cross the signal wiring, the crossing shall be as close to a right angle as possible. Wireways for 24 VDC wiring shall be used for all other wires and cables. Routing of 120 VAC in combined

wireways shall be minimized. Wires and cables shall be placed in the wireways in a straight, neat and organized fashion and shall not be kinked, tangled or twisted together. Additional wire ducting shall be provided for use by the electrical subcontractor for routing field wires to their landing points in the each electrical and instrumentation panel.

- b. Provide 2" minimum separation between wireway and terminal blocks.
- c. Wiring not routed in wireways shall be neatly bundled, treed, and laced with plastic ties.

C. Wire Terminations

- 1. Single wire and cable conductors shall be terminated according to the requirements of the terminal device as follows:
 - a. Crimp-on terminals: shall be UL listed, self-insulating sleeve type, with ring or rectangular type tongue, suitable for the size and material of the wire to be terminated, and for use with either solid or stranded conductors.
 - b. Terminal Blocks: Remove the last +/- 0.25 inches insulation from of the conductor and insert it under the pressure plate to full length of the bare portion of the conductor. Tighten the screw to close the pressure plate onto the conductor. No more than two conductors shall be installed in a single terminal. All strands of the conductor shall be captured under the pressure plate.
 - c. Screw-less terminals: wire shall be stripped back and inserted per the terminal manufacturer's instructions.
 - d. Motors with pigtail leads: Install terminal connectors on the motor pigtails and the cable to be connected. Terminals shall be non-insulated crimp-on type applied with a ratchet-type crimping tool. The terminals shall be bolted together with a nut, bolt and lock washer combination. The connection shall be wrapped with four (4) layers varnished cambric tape, six (6) layers of rubber tape and six (6) layers of vinyl electrical tape, each half lapped.
- 2. When stripping insulation from conductors, do not score or damage conductor.
- 3. The drain wire and stripped end of outer jacket of shielded cables shall be covered with heat shrink insulating tubing. The drain wire shall be covered along its full bare length between the cable jacket cover and the terminal lug and placed on end outer jacket to cover foil.
- 4. Condulets with wire nut connections shall be supplied for wire termination to devices with leads instead of terminals (i.e. solenoid valves, level probe, etc.).

D. Wire Splicing

- 1. No wires shall be spliced without prior approval.
- 2. Where splices are allowed or approved they shall conform to the following:
 - a. Wire splicing devices shall be sized according to manufacturer's recommendations.
 - b. Splices of #10 and smaller, including fixture taps, shall be made with nylon self insulated twist on wire nuts; T & B "Piggys", Ideal "Wing Nut" or equal.
 - c. Splices of #8 and larger shall be hex key screw, two way connectors, insulated with molded high-dielectric strength plastic; NSI Polaris IPL or IPLD Series terminal blocks or equal.
 - d. Non-Motor Splices #6 and smaller in underground pullboxes shall have wire-nut connections which are sealed with non-hardening silicone based sealant that protects the connection from moisture and corrosion. The

wire nuts shall be factory filled with sealant and UL listed for waterproof connections. Provide Ideal Model 60 or equal.

- e. Non-Motor Splices #4 and larger in underground pullboxes shall have double hex crimp barrel connections applied with adhesive/sealant filled heat shrinkable rubber insulation applied over the exposed connection. The cross-linked polyolefin shrink tube shall extend 4" on each side of the exposed connection minimum. Heat shrink tubing shall be 3M ITCSN or equal.
- f. Motor lead Splices in underground pullboxes shall have terminal connectors on the motor leads and the cable to be connected. Terminals shall be non-insulated crimp-on type applied with a ratchet-type crimping tool. The terminals shall be bolted together with a nut, bolt and lock washer combination. The connection shall be wrapped with four (4) layers varnished cambric tape, six (6) layers of rubber tape and six (6) layers of vinyl electrical tape, each half lapped. Seal the connection with epoxy resin coating.

E. Wire Installation

- 1. Exercise care in pulling wires and cables into conduit or wireways so as to avoid kinking, stressing the cables, or damaging the insulation. Use a UL listed pulling compound for lubrication within conduits as necessary. The raceway construction shall be complete and protected from weather before cable is pulled in. Swab conduits before installing cables and exercise care in pulling, to avoid damage to the insulation or conductors.
- 2. All wire and cables (with the exception of coaxial antenna cable) shall be installed within UL listed raceways or enclosures. Install all wires and cables in one continuous length unless splices are per Contract Drawings, required to connect equipment or submitted and favorably reviewed.
- 3. Bundle incoming wire and cables in panels. Zip-tie at intervals of 2" and neatly spread into trees and connect to their respective terminals. Allow sufficient slack in cables for alterations in terminal connections. Do not bundle, tape or tie wires within conduits.

3.03 WARRANTY

- A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

END OF SECTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Because of potentially long permit applications processes and manufacturing lead times for the generator equipment, the Contractor is required to submit the complete generator submittal within 14 days of notice-to-proceed and/or contract award.
- B. These specifications describe the minimum requirements for a STANDBY duty three phase engine driven generator. The “Generator Data Sheet” at the end of this specification lists the minimum sizing for the generator and accessories. A larger generator shall be supplied when necessary to meet the requirements of this section. The Contractor shall complete this form with proposed generator values and include it with the generator submittal.
- C. Generator(s) shall comply with local Air Quality Management District (AQMD) emissions requirements and utilize the AQMD’s current “Best Available Control Technology” (BACT) at the time of permit application. The permit application will be submitted by Owner within 4 weeks of the Generator submittal approval which needs to include pertinent emissions information.
- D. The generator shall be provided as described in the following specification and as shown on the Contract drawings, herein designated as the design documents. The generator shall comply with all applicable sections of NFPA 30, 37, 70, 72 and 110, California Fire Code Articles 79 and 80 as well as State Statues.
- E. The equipment furnished under these specifications shall meet the requirements of NEC Article 702, “Optional Standby Systems” and any other applicable articles of the NEC.
- F. The system shall meet the requirements of NFPA 704 Hazard Identification System Diamond indicating the hazards associated with the fuel being stored.
- G. The generator shall be delivered as a skid mounted unit, completely assembled to the extent possible and factory tested.
- H. Only new models in current production by a U.S. firm that meet the requirements of these specifications and which are cataloged by the manufacturer and for which manufacturer's published literature and printed specifications are currently available, will be considered. Special options may be included only when recommended by the manufacturer of the unit approved.
- I. All equipment/options are to be factory installed. If the equipment/options are not available factory installed, dealer installed equipment/accessories may be acceptable. The bidder is to specify those items which will be dealer installed in the submitted bid document.
- J. The manufacturer's local representative shall be an authorized distributor who maintains a stock of spare parts for the supplied generator and has a service facility with factory trained service personnel. The manufacturer's local representative shall be located within a radius of 200 miles of the project.

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- K. The Contractor shall perform complete startup, training and testing services for the generator per Electrical Specifications [Factory and Field Testing] and as detailed herein.
- L. Generator system shall be EPA Certified and meet all current Local, State and Federal air emissions requirements at time and location of installation.
- M. Generator system shall be coordinated and compliant with all current Local and State building and Fire Protection codes and requirements at time and location of installation. Furnish alarms, signage, fuel containment, shutdowns, and other devices and systems as required.
- N. The Contractor shall supply the generator, labor, testing and associated documentation as specified herein. This document describes the materials and intended operation, but does not necessarily describe all devices necessary for a functional system. All components and devices shall be furnished and installed as required to provide a complete, operable and reliable system for accomplishing the functions and meeting the performance set forth hereinafter.
- O. The generator scope of work includes:
 - 1. Engine driven electric generator
 - 2. Battery charger (120 VAC operated) mounted to generator frame.
 - 3. Sound attenuating housing.
 - 4. All auxiliary apparatus and accessories shall be provided as required for a fully functional generator and to meet local code requirements.
 - 5. Install a steel reinforced concrete pad, adequately sized to support the specified generator and fuel tank.
 - 6. All piping associated with exhaust system.
 - 7. Trenching, back filling, compaction and paving of each underground conduit route and fuel line piping.
 - 8. Field installation, startup, testing and training for the generator and associated equipment as part of this scope of work.
 - 9. Coordination with Utility/supplier for Natural Gas and LP gas services.

1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Project Drawings
- C. The following manufacturing and installation standards apply to this section:
 - 1. ASTM International (ASTM): A335/A335M, Specification for Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service.
 - 2. Meets local air resources board requirements at the time of permitting and installation.
 - 3. Code of Federal Regulations (CRF): Title 40 Volume 18, Control of Emissions from New and In-Use Non-road Compression-Ignition Engines.
 - 4. National Fire Protection Association (NFPA):
 - a. 37, Installation and Use of Stationary Combustion Engines and Gas Turbines.
 - b. 70, National Electric Code.
 - c. 110, Emergency and Standby Power Systems.
 - 5. SAE International (SAE): J1074, Engine Sound Level Measurement.
 - 6. Underwriters Laboratories, Inc. (UL):
 - a. 142, Steel Aboveground Tanks for Flammable and Combustible Liquids.

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- b. 2085, Protected Aboveground Tanks for Flammable and Combustible Liquids.
 - c. 508, Industrial Control Equipment.
 - d. 1236, Battery Chargers for Charging Engine-Starter Batteries.
 - e. 2200, Stationary Engine Generator.
- D. The bidder shall carefully examine the plans and specifications, and be familiar with the conditions of the location of installation.

1.03 QUALIFICATIONS

- A. Equipment manufacturers shall be represented by a company capable of servicing and testing the generator unit from a mobile service vehicle dispatched from within a 200 mile radius.

1.04 SUBMITTAL REQUIREMENTS

- A. Submit shop documents and drawings for approval in accordance with this subsection and as specified in Electrical Specifications [Electrical General, Submittal Requirements]. All non-relevant items not provided on this project shall be crossed-off or deleted from all submitted documents and drawings.
- B. Submit a specification compliance statement, describing differences between specified and proposed equipment. Note equipment provided specifically to meet local agency or authority having jurisdiction requirements.
- C. Complete “Generator Data Sheet” at the end of this section and submit this form with the generator submittal.
- D. Submit data sheets and catalog information detailing:
- 1. Engine:
 - a. Make and model.
 - b. Fuel type.
 - c. Number of cylinders and cylinder arrangement.
 - d. Bore and stroke.
 - e. Compression ratio.
 - f. Piston speed, Feet per Minute, at rated RPM.
 - g. Cylinder head, piston, valve, and block material.
 - h. Crankshaft material.
 - i. Main bearings, quantity and type.
 - j. Rated RPM and HP at rated RPM.
 - k. Governor type.
 - 2. Generator:
 - a. Make and model.
 - b. Generator full load electrical rating, KVA, KW, Voltage, Amperage, Frequency (Hz), # of Phases, # of Wires, Power Factor.
 - c. Generator and Exciter type.
 - d. Insulation material, class, and temperature rise.
 - e. Bearings, quantity and type.
 - f. Peak motor starting, KVA.
 - g. Voltage regulator type and regulation % from no load to full load.
 - h. Frequency regulator type and regulation %, from no load to full load.
 - i. One step load acceptance.
 - j. Unbalanced load capability.

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- k. Number of leads.
- l. Generator transient ($x'd$) and subtransient ($x''d$) reactance in per unit.
- m. Ambient temperature range.
- 3. Electrical
 - a. Control and instrument panel.
 - b. Generator main breaker.
 - c. Batteries and battery charger.
- 4. Cooling System
 - a. Maximum ambient temperature.
 - b. Capacity (gallons).
 - c. Coolant flow (gpm).
 - d. Fan diameter (in).
 - e. Fan HP requirement at rated RPM.
- 5. Accessories:
 - a. Exhaust silencer, stack, and piping system.
 - b. Fuel tank and piping system.
 - c. Vibration isolation system.
 - d. Block Heater system.
 - e. Weatherproof/Soundproof Housing as specified herein.
 - f. Paint Finish.

- E. Submit electrical schematics and wiring diagrams for:
 - 1. Generator control panel.
 - 2. Battery charging system.
 - 3. Main generator.
 - 4. Voltage regulator.
 - 5. Governing system.
 - 6. Generator main breaker.

- F. Submit dimension drawings for:
 - 1. Engine generator side, front, and top.
 - 2. Pad construction (minimum) size, anchor details.
 - 3. Enclosure (if required).
 - 4. Fuel tank and containment basin.
 - 5. Exhaust muffler and air intake baffle.
 - 6. Conduit stub-up areas under generator frame and/or sub-base fuel tank.

- G. Submit reports, calculations, and curves for:
 - 1. Generator sizing calculation (computer generated report acceptable) showing that the unit is sized adequately to start all loads as shown on Contract Drawings "Load Calculation" without exceeding the maximum voltage dip specified.
 - 2. Generator air emissions data, prototype or actual, suitable for submission to governing air quality management agency where generator is to be installed. Emissions data shall be for fuel type as required by local air quality agency.
 - 3. Sound level data showing that the complete generator package meets the sound level requirements stated herein.
 - 4. Engine generator fuel consumption data at 25%, 50%, 75% and 100% electrical loading.
 - 5. Proposed concrete pad dimensions, reinforcement method and isolation material (as necessary) for submitted generator.
 - 6. Seismic calculations for bolt down anchorage for seismic site class D. Calculation shall be signed by a California Registered Professional Structural Engineer. Generator installation shall meet applicable CBC or IBC requirements for stand-by power systems.

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- a. Calculations shall include calculations for wind loading on equipment to be mounted outdoors.
 - b. The Contractor shall submit a copy of the current ICBO anchor evaluation report for each type of anchor submitted.
 - c. The Contractor shall submit a copy of the concrete mix design to include the concrete design strength.
 - d. The Contractor shall submit Near Fault Vicinity and Location maps.
7. Battery sizing calculations showing all anticipated DC “black start” loads, and performance requirements including battery charger sizing and maximum recharge time.
- H. Air Quality Management Applications and Permits
1. The Contractor shall obtain the correct ATC application from the AQMD and preliminarily complete the application by inserting the project specific generator technical information. Submit preliminary partially completed application to the Engineer for use by the Owner in preparation of the final completed ATC application.
 2. The Contractor shall submit all generator specific information required to complete the ATC permit application. The Owner will not submit the application until all the information is received and the submittal receives a status of “make corrections noted” or “approved.” Submit information in sufficient time for application processing and submittal review as to not delay project completion. The generator will not be considered fully approved until the ATC permit is obtained.
 3. The Owner shall complete and apply for the "Authority to Construct" (ATC) permit from the Air Quality Management District or Board with jurisdiction for this generator system. Fees for permit and application will be paid by the Owner. The Owner will submit the permit application within 4 weeks of submittal approval. Allocate 4 weeks for Owner to obtain ATC permit once application has been submitted.
 4. The Contractor shall confirm that the submitted generator meets all local AQMD guidelines prior to submittal of the generator unit or preliminary application. Failure to do so will delay the ATC permitting and submittal approval.
- I. Descriptive literature shall be provided that describes the generator and all accessories. This literature shall provide sufficient detail to determine that the generator has all the accessories, options, features, and characteristics specified herein. Items that are not provided shall be neatly lined out.
- J. Deviations from the Contract documents shall not be incorporated into the work without prior written approval. A "Change Order" directive is required prior to incorporating any deviation from the Contract documents that has costs associated. The cost differential associated with this change order must be negotiated to amend the Contract to reflect the costs or savings.
- K. Exceptions to the Specifications or Drawings or equipment or procedures submitted as “equal” to specified equipment shall be clearly identified by the equipment supplier in a letter at the front of the submittal. Submittal data for “equal” equipment or procedures shall contain sufficient details so a proper evaluation may be made. The Contractor is responsible for verifying proper application/operation of substituted equipment.
- L. The decision of the Owner governs what is acceptable as an approved equal. If the Owner considers it necessary, tests to determine equality of the proposed substitution

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shall be made, at the Contractor's expense, by an unbiased laboratory satisfactory to the Owner. Equality will be judged on the basis of the following:

1. Conformance with description or performance required.
2. Equal in quality.
3. Comparable in operation and maintenance.
4. Equal in longevity and service under conditions of climate and usage for given application.
5. Conformance with space allocations.
6. Comparable in appearance and artistic effect.
7. Compatible with mechanical and electrical construction of related work without necessitating changes in detail.

- M. The Owner will not accept any ownership for material or equipment until the corresponding submittals have been reviewed by the Owner and approved.
- N. Submit complete and specific information with regard to equipment representatives and service facilities.

1.05 OPERATION AND MAINTENANCE INFORMATION

- A. Provide six (6) sets of operating, maintenance & parts instructions in original manuals (no copies allowed).

PART 2 PRODUCTS

2.01 QUALITY

- A. The generator shall be as manufactured by Caterpillar, Cummins, Generac, Kohler or equal with accessories as defined herein.
- B. The equipment supplied and installed shall meet the requirements of the National Fire Protection Association (NFPA 70 and NFPA 110) and all applicable local codes and regulations.
- C. The generator system shall be designed as a "black start" unit capable of starting and operating without any external power.
- D. Provide all of the features, options, and accessories specified herein and shown on the design drawings. Finished equipment shall be complete and site tested as an installed unit with all accessories functioning.
- E. All rotating parts shall have guards to protect against accidental contact in accordance with Federal OSHA and Cal-OSHA requirements.

2.02 RATING

- A. The engine generator shall have a minimum continuous standby rating as listed in "Generator Data Sheet" at the end of this section. Standby rated shall mean that generator starts within 60 seconds upon being called and operates continuously for the total duration of the generator call or fuel supply. Rating of the generator shall be based on operation when equipped with all necessary operating accessories such as radiator, fan, air cleaners, lubricating oil pump, governor, exhaust silencer, etc.

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- B. No derating from the ratings specified shall occur for ambient temperatures below 122°F or installation elevation below 1,000 feet.
- C. The engine/generator shall accept 100% of its nameplate rating at 0.8 PF in one step, in compliance with NFPA 110, Paragraph 5-13.2.6.
- D. The generator shall be capable of successfully providing three phase, four wire, 60 hertz power to start and continuously operate at the specified KW rating and below for loads shown in the drawing and/or with power factors between 0.5 lag to 0.9 lead. It shall be capable of operating in noisy electrical environments that are typical of variable frequency drive motor loads. The nominal voltage and maximum step voltage dip shall be per the "Generator Data Sheet," as measured line to line at the generator terminals, during start of any of the station loads.
- E. Generator set mean time between failures shall be a minimum of 5,000 hours.

2.03 ENGINE

- A. The engine shall be a Dual Fuel ignition engine type, water cooled, four cycle, with vertical inline or V type cylinders and an overhead valve configuration.
- B. The engine shall utilize natural gas fuel with LP gas backup. Generator shall operate per manufacturer's specifications using dual fuel and meet requirements of local air quality authorities.
- C. The engine shall have sufficient power to produce the specified ratings when operating with all accessories including exhaust, fuel, cooling, and battery charging systems, etc.
- D. Engine fuel system:
 - 1. Carburetor.
 - 2. Secondary Gas Regulators: One for each fuel type, with atmospheric vents piped to the building exterior.
 - 3. Fuel-Shutoff Solenoid Valves: UL-listed, normally closed, safety shutoff valves; one for each fuel source.
 - 4. Fuel Filters: One for each fuel type.
 - 5. Manual Fuel Shutoff Valves: One for each fuel type.
 - 6. Flexible Fuel Connectors: Minimum one for each fuel connection.
 - 7. LP gas orifice provision.
 - 8. The fuel inlet should be integrated into the side of the generator skid from the factory for ease of installation. Both LP and NG fuel inlets must be on the same side integrated into the generator skid.
 - 9. Natural Gas with LP Backup Operation:
 - a. Automatic transition from the primary fuel source (natural gas) to the secondary fuel source (propane), if primary fuel source pressure becomes insufficient.
 - b. Generator continues to operate on the secondary fuel source until one of three conditions occur at which point the generator will transition back to the primary fuel source:
 - 1) Secondary fuel source pressure becomes insufficient.
 - 2) Generator shuts down.
 - 3) User manually engages dual fuel reset box.
 - c. The controller must adjust internal ratings and control set points automatically when switching between fuel sources. The controller must

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use ratings for natural gas when operating on natural gas and adjust to the ratings for LP when operating on LP.

- d. The controller must offer a means to use load shed to ensure the generator does not experience an overload condition when operating on a fuel source with a lower rating.
- E. The engine shall be equipped with:
1. Electrical governor; consisting of a magnetic pickup speed sensor, adjustable electronic control, and an electrical actuator mounted integrally with the fuel pump. The governor shall provide automatic engine generator set frequency regulation adjustable from isochronous to 5% droop. Governors using external throttle linkages are not acceptable.
 2. An electric starting system complete with batteries, battery charger, battery rack, connector cables, and any other equipment required to start the standby generator. The starting system shall not require an auxiliary AC power supply to start, fully load, and operate the standby generator. The batteries shall be sized to provide five starts with 30 seconds cranking for each start attempt. The battery charger shall be sized to fully recharge the batteries within 12 hours. If required to maintain the above criteria, an electrical heat pad for the batteries shall be provided to keep the batteries in a ready state at the specified minimum ambient temperature. The charger shall be furnished with charger trouble alarm and an automatic equalize timer for fast recharge. The charger shall alarm on loss of power and cause a generator common alarm output.
 3. Positive engagement solenoid shift starting electric starter with DC voltage as listed in "Generator Data Sheet."
 4. Battery charging alternator with a minimum ampere output as listed in "Generator Data Sheet."
 5. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain. The oil pump shall be capable of supplying adequate lubricating oil under pressure to the main bearings, crankshaft bearings, pistons, piston pins, timing gears, camshaft bearings, and valve rocker mechanism. The cartridge oil filters shall be full flow type, conveniently located for servicing. Filters shall be equipped with a spring loaded bypass valve to ensure oil circulation if filters are clogged.
 6. An electric DC motor-driven pre-lube oil pump shall be provided if required by the engine manufacturer's design for "black start" of the standby generator.
 7. Dry type replaceable air cleaner elements. The dry-type air cleaner shall be equipped with a self-cleaning dust and water evacuator and a vacuum restriction gauge to indicate maximum allowable restriction of the air cleaner system according to the engine manufacturer's recommendations. The air cleaner elements shall be conveniently located for servicing. The air filters shall be supplied with automatic swing open louvers to allow inlet air flow during engine operation.
 8. Unit mounted radiator, blower fan, water pump, and thermostat. The radiator with blower type fan shall be sized to maintain safe operation at 122° F ambient temperature. The engine cooling system shall be filled with a solution of 50/50 ethylene glycol/water antifreeze or equivalent as recommended by the manufacturer.
 9. Replaceable type cylinder liners.
 10. Replaceable insert main bearings.

2.04 GENERATOR

- A. The generator shall be a synchronous wye-connected generator designed for direct connection to the engine. It shall be salient-pole, brushless, 12-lead reconnectable, self-ventilated, drip-proof construction, with amortisseur rotor or damper windings and skewed stator for smooth voltage waveform. The unit shall conform to the applicable standards for synchronous generators, salient pole type.
- B. The generator shall have the following features:
 - 1. Temperature rise of the rotor and stator shall be limited to 125° C for the specified KW and KVA ratings.
 - 2. Steady state voltage regulation from no load to full load within +/- 0.25% for electronic governors, +/- 0.8% for mechanical governors.
 - 3. Steady state regulation from no load to full load within +/- 0.25%.
 - 4. The insulation material shall meet the NEMA standard (MG1 22.40 and 16.40) for class H and be vacuum impregnated with epoxy varnish to be fungus resistant per MIL I 24092.
 - 5. The excitation system shall be of brushless construction controlled by a solid state voltage regulator with adjustable volts per hertz operation capable of maintaining voltage within +/- 2% at any constant load from 0 to 100% of rating. The regulator isolated from the load to prevent tracking when connected to SCR loads. The regulator shall be protected from the environment by conformal coating and provide individual adjustments for voltage range, stability and volts-per-hertz operations. Provide permanent magnet (PM) excitation for generators above 150KW or AREP excitation for generators smaller than 150KW.
 - 6. The generator shall have a single maintenance-free bearing and be connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
 - 7. Radio interference suppression to meet the BS.800 and VDE Class G and N standards.
 - 8. Telephone interference factor of less than 50 per NEMA MG1-22.43.
 - 9. AC voltage waveform total harmonic distortion of less than 5% total from no load to full load. Any individual harmonic shall have less than 3% THD.
- C. The generator shall be inherently capable of sustaining at least 300% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current support devices.
- D. On starting each listed load, the instantaneous voltage dip shall not exceed that listed in "Generator Data Sheet" and shall recover to +/- 1% of rated voltage within one second.

2.05 CONTROLLER & INSTRUMENT PANEL

- A. Provide a generator set mounted controller & instrument panel. The controller top shall be mounted no higher than 6 feet above finished grade. Controller mounting shall be vibration isolated from the rest of the engine / generator set.
- B. Emergency stop maintained pushbutton located at maximum 6 feet above grade.
- C. On-board paralleling equipment for future use.
 - 1. Controls to sense voltage phase and angle.
 - 2. Contactor to automatically connect to line voltage given a live buss or dead buss.
 - 3. Furnish Kohler APM603 and MP603 or equal.

- D. Controller Features
 - 1. All solid state construction, except for interface relays. The controller shall utilize a microcomputer based logic with a ROM based control algorithm. Circuit boards shall be coated to protect from environmental damage.
 - 2. Graphical display with preconfigured screens for parameter and alarm viewing and setpoint changes.
 - 3. Voltage, current and power metering, engine and generator parameter viewing.
 - 4. Real time clock for time stamping of diagnostic events and maintenance reminders.
 - 5. Non-volatile memory for setpoint storage through power failures.
 - 6. Security through password access.
 - 7. Control of generator output circuit breaker for generator protection and synchronizing functions.
 - a. Paralleling functions to including automatic and manual synchronizing, dead bus arbitration, load sharing, and load sense/load demand.
 - b. Protective relaying functions – phase sequence, over/under voltage, over/under frequency, reverse power, overcurrent, current balance.
 - 8. Provisions for communications to adjacent generator units for paralleling and load sharing.

- E. Control circuitry shall be of plug in design for quick replacement. The controller shall be equipped to accept a plug in device capable of allowing maintenance personnel to test controller performance without operating the engine. The controller shall be capable of operation from –40°C to 85°C.

- F. Input circuitry from fuel tank devices such as fuel level switches and level transmitters, shall be designed to be suitable for the application and consist of current limiting circuitry and/or non-sparking devices.

- G. Generator Exercise Timer: Timer clock provided for operator adjustment of day of week, time of day and run duration for exercising the generator on a set schedule. Timer shall be integral to the generator control panel.

- H. Control must meet NFPA-110 Level 1 requirements and meet NFPA-70.

- I. The panel display shall include as a minimum:
 - 1. AC voltmeter.
 - 2. AC ammeter.
 - 3. Frequency meter.
 - 4. Water temperature gauge.
 - 5. Oil pressure gauge.
 - 6. Battery voltmeter gauge.
 - 7. Engine running time meter (non-resettable)
 - 8. Voltage adjustment.
 - 9. Pre-alarms:
 - a. Auxiliary fault.
 - b. Battery Charger Fault.
 - c. Fuel low level/pressure.
 - d. Low oil pressure.
 - e. Low engine temperature
 - f. High engine temperature.
 - g. High battery voltage
 - h. Low battery voltage
 - i. Fuel leak alarm

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10. Engine shutdowns:
 - a. Auxiliary Shutdown.
 - b. Emergency Stop.
 - c. Low coolant level
 - d. Overcrank.
 - e. Overspeed.
 - f. Low oil pressure.
 - g. Low fuel level.
 - h. High engine temperature.
 11. Audible Alarm:
 - a. Generator switch not-in-auto.
 12. Functions:
 - a. Three position (RUN-OFF AUTO) function: In the RUN position the engine shall start and run regardless of the position of the remote starting contact. In the AUTO position, the engine shall start when contacts in the remote control circuit close and stop five minutes after those contacts open following the engine cooldown sequence. In the OFF position the engine shall not start even though the remote start contact closes. This position shall also shutdown engine immediately.
- J. Wiring – The manufacturer shall furnish, install at the factory, and test all wiring required between devices mounted within or on the standby generator unit base. All wiring shall be neatly and carefully installed in wiring gutters, wire looms, or raceway. All power supply circuits shall be provided with suitable isolation/electrical protection means consisting of either fuses or circuit breakers. All internal wiring shall be marked at both ends of the conductor.
- K. Operation:
1. Two wire generator start/stop control from an automatic transfer switch (normal start and stop with cooldown).
 2. Engine starter control for:
 - a. Cranking cyler with 15 second ON and OFF cranking periods or as recommended by the manufacturer. Cranking shall cease upon engine starting and running.
 - b. Two methods of cranking termination shall be provided:
 - 1) After three 15 second cranking cycles.
 - 2) After 75 seconds if the engine fails to start or as recommended by the manufacturer
 - 3) Each condition shall lockout the engine, and visually indicate an overcrank alarm.
 - c. Starting system shall be designed for restarting in event of a false engine start. It shall permit the engine to completely stop rotating before reengaging the starter.
 3. Provide wiring circuitry and sensing devices as required for emergency shutdown of the engine on any occurrence of the following conditions.
 - a. Low coolant level.
 - b. Over speed.
 - c. Over crank.
 - d. High engine temperature.
 - e. Low oil pressure.
 - f. Emergency stop
 - g. Auxiliary shutdown
 4. Engine cool down timer factory set at five (5) minutes to permit unloaded running of the generator set after the call to operate is dropped.

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5. Programmable I/O contacts to be provided and brought out to terminals for connection to remote monitoring equipment:
 - a. A common alarm dry contact, normally open which closes on any alarm condition.
 - b. A generator running dry contact, normally open which closes when the engine is running.
 - c. A generator in cool-down dry contact, normally open which closes when the engine is running but opens when the engine enters cool-down.
 - d. Low fuel level dry contact, normally open which closes on low fuel alarm condition.
 - e. Fuel level (0-100% full) 4-20 mA output for PLC/SCADA monitoring.
 - f. Auto switch position dry contact that closes when the three position (RUN-OFF AUTO) selector switch is in the "AUTO" switch position.
 - g. Remote emergency shutdown from normally closed switch.

2.06 ACCESSORIES

- A. Engine block heater. Thermostatically controlled and sized to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA-99 and NFPA-110, Level 1. Wattage and voltage shall be per "Generator Data Sheet."
- B. Exhaust System:
 1. The complete exhaust system (silencer, stack, and exhaust piping) shall be sized to ensure that exhaust back pressure falls within the manufacturer's minimum and maximum limitations under all operating conditions.
 2. Exhaust Silencer: Provide exhaust silencer including flexible piping & fittings properly sized and installed according to the manufacturer's requirements. The silencer shall be critical type (30dB attenuation minimum) and coated to be temperature and rust resistant. The flexible connector section(s) shall be seamless, stainless steel and the ends shall be pipe thread (2" maximum) or SAE flanged. Support for exhaust silencer shall be from overhead or side supports or as shown and shall not be carried by the exhaust manifold.
 3. Exhaust Stack and Piping: Provide thin-gauge steel pipes with flange connections, high temperature gaskets, elbows and straight runs to complete the exhaust system. The exhaust system shall extend vertically above roof to direct exhaust and heat away from building or enclosure or as shown on the drawings. Provide wall thimble and roof penetrations designed for high heat applications and a gravity actuated steel rain cap at end of exhaust pipe. Exhaust system shall be supported from side or above utilizing galvanized steel channel trapeze hangers, gusseted wall brackets or custom welded brackets per manufacturer's recommendations to meet the specified seismic design conditions. Design system to accommodate engine vibration and not loosen or break exhaust system mounts.
 4. Provide threaded welded half coupling on exhaust piping, ¾" copper drop pipe and ball valve to drain condensate from muffler and exhaust stack. Mount piping on wall with channel supports. Drain outlet shall be plumbed down the nearest wall such that a 5 gallon bucket may be slid beneath to catch discharge. Exhaust piping and muffler shall be sloped 2% such that drains are at the low points.
 5. Insulation system: The non-outdoor portion of the exhaust pipe, stack and silencer shall be covered with fiberglass insulation and soft outer cover. The outer cover shall be constructed of heat and fire resistant canvas material with snap buttons.
- C. Vibration Isolation

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1. Engine Generator: Vibration isolation dampeners between the engine and steel mounting skid.
 2. Exhaust Silencer: Mount with vibration isolators and/or flexible exhaust piping.
 3. Enclosures shall be mounted with vibration isolators and/or steel structural stiffeners to minimize added noise due to vibration.
 4. The generator shall have provisions for shipping/transit such that expected shocks will not damage the vibration isolators or generator.
- D. Batteries: Support tray with plastic battery enclosure, tie downs, battery cables, and 12-volt batteries all mounted to the engine/generator skid. The batteries shall be capable of delivering the cold-cranking amps required at zero degrees Fahrenheit per SAE Standard J-537.
- E. Signage:
1. Signage shall be posted on the sides of the generator enclosure facing the main approaches to the system.
 2. Provide an engraved placard with fuel filling procedure, tank capacity, fuel type, and maximum fill guidelines.
 3. Provide signage 0.08" thick white painted/silk-screened aluminum with 1-1/2" red lettering to read "No Smoking". Signs shall be posted on all sides of generator enclosure.
 4. Provide signage 4" x 6" x 0.08" white painted aluminum with red lettering to read "Generator Emergency Stop" for installation at a remote emergency stop switch as shown on the drawings.
- F. Automatic Battery Charger suitable for continuous operation to maintain the battery charge voltage with no manual intervention. Battery charger features shall be as follows:
1. Solid state circuitry with charging modes as described to automatically recharge the starting batteries. When battery voltage drops below the specified value the battery charger shall operate at the high rate constant current mode until the battery voltage rises to the preset equalize level. The equalize mode will continue until the current required to maintain this voltage drops to 50% of the high rate level.
 2. A current limiting circuitry to prevent charger overload under low battery voltage conditions. Provide minimum DC voltage and amp ratings (minimum) as listed in "Generator Data Sheet."
 3. The battery charger shall provide temperature compensation of 2 mv/°C per cell over the ambient temperature of -40°C up to 60°C. This shall automatically adjust the "float" and "equalize" voltage settings to prevent the batteries from overcharging at high temperature and under charging at low ambient temperatures.
 4. The complete charger unit shall be U.L. listed.
 5. The charger shall be mounted to the engine/ generator skid. The charger shall be operational through an ambient temperature range of -40°F to 140°F. It shall include the following features:
 - a. Fused AC input and DC output overload & short circuit protection.
 - b. DC ammeter and voltmeter, 5% full scale accuracy, to indicate battery charging amps and volts.
 - c. "Power on" lamp to indicate when the charger is operating.
 - d. DC voltage regulation +/- 1% from no load to full load and over AC input line variations of +/- 10%.
 - e. Reverse polarity protection to prevent the charger from energizing outputs if improperly connected.

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- f. Current limiting. Current limiting circuitry shall be provided to prevent damage to the charger from being overloaded at low battery voltage such as occurs during short circuit conditions or during engine starter cranking.
 - g. The battery charger shall be powered from 120 VAC.
- G. Sound Attenuating Weatherproof Housing for the generator shall be as follows:
- 1. Manufactured from heavy-gauge aluminum or galvanized sheet steel and painted with the manufacturer's standard finish. Paint color shall be submitted to Owner for approval. Color choices shall include but not be limited to autumn white and beige. All surfaces shall be painted inside and out.
 - 2. The interior of housing shall have a heat resistant thermo-acoustic insulation system designed to meet sound attenuation requirements for the life of the generator. The placement, type, thickness and weight of the attenuator panels shall provide sound dampening to the specified level of allowable noise outside the generator. The air intake and exhaust shall have similar dampening and allow ample air flow for proper engine cooling, without having to remove side panels. The insulation shall be mechanically held against walls, ceiling and doors behind full sheets of perforated galvanized sheet steel. All insulation shall be covered with the exception of the exhaust piping.
 - 3. The enclosure shall house the engine, generator, control & instrument panel, battery charger, generator breaker, and all accessories.
 - 4. The radiator discharge shall be directed upwards through the use of a vertical duct mounted to the enclosure. The duct shall include drip holes to allow rain water to drain out the bottom.
 - 5. All exterior panels shall have lockable latches to prevent unauthorized entry.
 - 6. The specified exhaust silencer shall be mounted in or on the roof of the enclosure with vibration isolators.
 - 7. Pressure drops through the enclosure openings shall not exceed limits set by the manufacturer of the generator.
 - 8. The enclosure shall be free standing and anchored to the concrete pad (or trailer) supporting the engine generator. The enclosure may be mounted to the generator skid only if a skid mounted enclosure can meet the sound attenuation requirements specified.
 - 9. The enclosure shall be designed so that sound levels measured at a 25 feet radius from any side of the enclosure (free field) and 5 feet above ground level, noise levels shall not exceed (Generator Data Sheet) dB with the engine generator running at full load and full speed inclusive of exhaust noise.
- H. MOLDED CASE CIRCUIT BREAKERS
- 1. General
 - a. Circuit breakers and motor circuit protectors shall be manufactured by Eaton Cutler-Hammer, Square D, G.E., Siemens, or equal.
 - b. Circuit breakers shall be the bolt-on type.
 - c. Multiple-pole circuit breakers shall be designed so that an overload on one pole automatically causes all poles to open. The use of tandem or dual circuit breakers in a normal single-pole space to provide the number of poles or spaces specified are not acceptable.
 - d. Molded case circuit breakers shall be operated by a single toggle-type handle and shall have a quick-make, quick-break switching mechanism. An automatic trip of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and have flash reduction arc chutes. A push-to-trip button on the front of the circuit

- breaker shall provide a local manual means to exercise the trip mechanism.
- e. Minimum interrupting capacity:
 - 1) 480 volt circuit breaker shall have a minimum interrupting capacity of 65,000 amperes.
 - 2) 120 or 208 or 240 volt breaker shall have a minimum interrupting capacity of 10,000 amperes
 - f. Circuit Breakers protecting full voltage or solid state reduced voltage motor starters shall be motor circuit protector (MCP) breakers with adjustable magnetic trip unless otherwise noted on the drawings.
 - g. Circuit breakers shall be UL listed for series application.
 - h. Where indicated circuit breakers shall be current limiting.
 - i. Where indicated on Drawings, provide UL listed circuit breakers for continuous duty at 100% of their ampere rating in the intended enclosure.
 - j. Furnish add-on features such as auxiliary position status contacts, trip indication contacts, zone interlocking, shunt trip coils, etc, as shown in the drawings.
2. Trip Unit – Molded Case Circuit Breakers
- a. Circuit Breakers over 400 volt and over 90A trip units as defined herein. All other circuit breakers shall have shall have non-electronic thermal-magnetic (TM) trip units with inverse time-current characteristics.
 - b. The trip unit shall be Eaton type Power Expert Release (PXR) or equal.
 - 1) Each circuit breaker trip unit shall have three (3) current sensors, voltage sensors, microprocessor, and flux transfer trip solenoid at minimum.
 - 2) Trip units shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.
 - 3) Trip units shall be powered from the primary voltage connected to the circuit breaker. Current flow shall not be required for settings functions. Circuit breaker trip units shall be operable and adjustable with zero current flowing through the circuit breaker.
 - 4) True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current and voltage sensors, and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time-delay settings are reached.
 - 5) Trip units shall be provided with a display panel. Trip units shall have an information system that provides LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip
 - 6) Programming may be done via a keypad at the faceplate of the unit. Programming via the communication network if or as shown in drawings.
 - 7) The trip unit shall offer a three-event trip log that will store the trip data, and shall time and date stamp the event.
 - 8) The trip unit shall have the following advanced protective features integral to the trip unit:
 - a) Adjustable undervoltage release (defeatable)
 - b) Adjustable overvoltage release (defeatable)

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- c) Reverse power and fault current
 - d) Reverse sequence voltage
 - e) Under-frequency
 - f) Over-frequency
 - g) Voltage phase unbalance and phase loss during current detection.
 - 9) Although not preferred but if needed, furnish 24VDC redundant power supply with terminal blocks and 0.5A miniature circuit breakers to distribute control power to each circuit breaker trip unit that requires it for settings. The power supply shall be connected below the main breaker and transfer switch but above any feeder circuit breakers. Provide option for external power supply input.
 - c. System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:
 - 1) Adjustable long-time setting (set by adjusting the trip setting dial to an amount not to exceed rating plug)
 - 2) Adjustable short-time setting and delay with selective flat or I²t curve shaping,
 - 3) Adjustable instantaneous setting
 - 4) Adjustable ground fault setting and delay with selective flat or I²t curve shaping.
 - d. The microprocessor-based trip unit shall have both powered and unpowered thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.
 - e. Furnish internal ground fault protection with adjustable settings. Provide neutral ground fault sensor for four-wire loads. Bypass neutral sensor for 3 wire loads.
 - f. Include ARMS technology for all circuit breakers 400A and above or where shown on drawings.
 - 1) Activation and deactivation of the ARMS technology and local indication shall be accessible from the face of the trip unit without opening the circuit breaker door or cover and exposing operators to energized parts.
 - 2) Recalibration or adjustment of trip unit parameters shall not be required when enabling / disabling the ARMS technology.
 - g. Breakers shall have built-in test points for testing the long-time delay, instantaneous, and ground fault functions of the breaker by means of a test set.
3. Manual operators
- a. Furnish manual operators for mains and selected feeder circuit breakers as shown in the drawings.
 - b. Manually operated mechanisms designed to open, close and reset circuit breakers.
 - c. Operators shall be available in three basic configurations— flange mounted, through-the door rotating and direct handle through door to provide a variety of options for different applications and enclosure ratings.

PART 3 EXECUTION

3.01 WORKMANSHIP

- A. The construction methods specified herein shall be followed by the manufacturer of the generator. If the manufacturer fails to comply, the Contractor shall pay all costs required to make the changes to the equipment to conform to these construction methods.
- B. Screw type solderless terminals or lugs shall be provided for all field connected power cables, control and instrument wiring. All connections shall be accessible from a designated connection panel without removal of internal components.
- C. A terminal strip shall be provided for control and instrument wiring. Number all terminals with machine printed lettering.
- D. All internal and external control and instrument wiring shall have permanent identification at each point of connection. Wire identification shall be by machine printed numbered "shrink-tube" wiring sleeves. Internal wire numbers shall be per generator manufacturer's wiring diagram. External wire numbers shall be determined by the connected control panel(s).
- E. Control and instrument wiring shall be neatly bundled and secured in place with screw down anchors and plastic cable ties. Wiring shall be protected with plastic spiral wrap where it is subject to mechanical damage or crosses over to a hinged door.
- F. The generator and any accessories shall be a product of excellent workmanship and shall be free from any defects or imperfections that will affect their appearance or serviceability.
- G. The generator's neutral shall be grounded per generator manufacturer's installation instructions for 3 wire distribution systems.

3.02 INSTALLATION

- A. The generator shall not be delivered to the job site until the manufacturer's certified factory test report has been submitted, reviewed and accepted. A non-existent or non-reviewed certified factory test report shall be sufficient cause for the unit to be rejected.
- B. The Contractor shall remove rejected equipment immediately from the jobsite at his expense until the generator submittal and/or factory test report is approved.
- C. Gaseous Fuel Connections:
 - 1. Connect fuel piping to engines with a gate valve and union and flexible connector. Install manual shutoff valve in a remote location to isolate gaseous fuel supply to the generator.
 - 2. Vent gas pressure regulators outside building a minimum of 60 inches (1500 mm) from building openings.

3.03 FACTORY INSPECTION AND TESTS

- A. Factory or Factory Authorized Dealer shall be considered one in the same for the purposes of inspection, testing, service facility and herein after may be referred to as "factory" or "manufacturer."

- B. Factory Tests: Each generator to be supplied shall be tested by the manufacturer prior to shipment. All tests shall be made with all accessories installed. The factory tests shall be made under varying loads (30% to 100%) for a minimum of one hour total.

The factory testing shall include the following tests:

1. Single step load pickup.
2. Transient and steady state governing.
3. Safety shutdown device testing.
4. Voltage regulation.
5. Rated power.
6. Maximum power.
7. Test all generator control panel alarms, status lights & indicators.
8. Test all remote connection status and alarm points (dry contacts).
9. Simulate remote ATS start/stop of generator utilizing a wire jumper.

- C. Leak Test: After installation, inspect exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
- D. A typewritten factory test report shall be provided which lists the factory tests performed. The results of the each test, name & phone number of person who performed the tests, date(s) when tests were performed, serial & part number of equipment tested, setting values, failures encountered, and repairs made during testing.

3.04 FIELD ASSISTANCE

- A. The Contractor shall take all precautions necessary to ensure the safety of all personnel during the tests. Absolutely no tests shall be run that could potentially cause injury or jeopardize personnel safety.
- B. The initial setup of each generator shall be performed by a factory trained service person of the manufacturer's local representative. Fill the engine fuel, lubricants, and cooling system and make all preliminary tests and checks required before engine start up the day prior to witness field testing.
- C. The Contractor shall be responsible for and pay the costs for the necessary fuel to fill each generator tank prior to the start of the field tests. The fuel shall include a fuel conditioner as recommended by the manufacturer.
- D. The Contractor shall pay for a factory-trained service representative to perform one (1) 8-hour day of field tests for each generator, beginning at 8:00 a.m. any weekday, except Friday.
1. Each failure mode, alarm, and control function shall be demonstrated to Owner by the Contractor's factory-trained service representative prior to performing any other field tests.
 2. The generator manufacturer representative shall furnish a temporary 1.0 PF load bank and connection cabling rated for a load equal to no less than 100 percent of the generator nameplate KW. The load bank shall be connected to the generator output terminals for a four (4) hour, full load test. The Owner Representative shall be allowed to change loads during the tests to simulate normal operating conditions. The factory trained service person shall be responsible for running the generator during the load tests. Any defects or failures discovered during these tests shall be corrected or adjusted by the factory trained service person. The engine generator load test shall be restarted after each repair or adjustment that requires shutdown of the generator. The test shall be restarted as many

times as necessary until the generator runs for four (4) continuous hours without shutdown or failure.

3. The temporary load bank shall be set-up the day before testing. Under no circumstances shall the testing be allowed to extend beyond 5:30 p.m.
4. All field tests shall be witnessed by Owner. Written notice shall be provided to the Owner Representative seven (7) days prior to the date for the field test.

E. Training

1. The local representative's factory trained service person shall instruct in the proper operating and maintenance procedures for all components of the generator. This instruction shall be given for a minimum length of two (2) hours. The training shall cover "operation" and "maintenance". Training shall not begin until Operation and Maintenance manuals are approved and field tests have been completed.

3.05 WARRANTY

- A. The Generator System Supplier shall have a staff of experienced personnel available to provide service on two (2) working days notice during the warranty period. Such personnel shall be capable of fully testing and diagnosing the equipment delivered; and of implementing corrective measures.
- B. If the Generator System Supplier fails to respond in two (2) working days, the Owner at its option will proceed to have the warranty work completed by other resources; the total cost for these other resources shall be reimbursed in full by the Contractor. The use of other resources, as stated above, shall not change or relieve the Contractor from fulfilling the remainder of the warranty requirements.
- C. Prior to final acceptance, the Contractor shall furnish a listing of warranty information for all manufacturers of materials and equipment supplied under the scope of work covered in these design documents. The listing shall include the following:
 1. Manufacturer's name, service contact person, phone number, and address.
 2. Material and equipment description, equipment number, part number, serial number, and model number.
 3. Warranty expiration date.
- D. Hardware support:
 1. The Contractor shall provide warranty of all equipment for a period of one (1) year from date of final acceptance. Standard published warranties of equipment which exceed the preceding specified length of time shall be honored by the manufacturer.
 2. The Contractor shall provide all labor and material to replace or repair any hardware that fails during the warranty period, at no additional cost to the Owner.

3.06 FINAL ACCEPTANCE

- A. Final acceptance will be given by the Owner after the equipment has been field tested satisfactorily, each deficiency has been corrected, documentation has been provided, and all the requirements of design documents have been fulfilled.
- B. At the end of the project, following the completion of the field tests, and prior to final acceptance, the Contractor shall provide the following to the Owner:
 1. Fuel tank top off. The Contractor shall supply up to one entire tank of fuel at the end of the project.

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2. Each "operation, maintenance and parts" manual shall be modified or supplemented by the Contractor to reflect all field changes and as built conditions.
3. Two sets of keys for all locks.

GENERATOR DATA SHEET

The following data sheet is a summary of generator required specifications. Not all specification requirements are listed below. The Contractor/Supplier shall return this page with the Submitted Value column completed. If submitted values are less than those listed in the Specification Minimum column, then the supplier shall explain reasons for the exception in cover letter.

Description	Specification Minimum	Units	Submi Value	Units
Generator Continuous Output Power (Oversize alternator may be required)	400	KW		KW
	500	KVA		KVA
Three phase voltage (Nominal)	480	Volts AC		Volts AC
Continuous amperage at 0.8 power factor	588	Amps AC		Amps AC
Power Frequency	60	Hz		Hz
Maximum voltage dip with motors per load calculation (defines alternator size)	15	%		%
Reactance – Subtransient (X''d)	**	%		%
Reactance – Transient (X'd)	**	%		%
Reactance – Synchronous (Xd)	**	%		%
Engine horse power at rated KW	**	HP		HP
Engine RPM at rated power	1800	RPM		RPM
Engine Fuel Type	Dual Fuel	-		-
Engine aspiration (Normal/Turbo)	Turbo	-		-
System Voltage	**	Volts DC		Volts DC
Alternator output (at system voltage)	**	Amps DC		Amps DC
Battery charger output	10	Amps DC		Amps DC
Engine block heater power	**	W		W
Alternator condensation strip heater	**	W		W
Heater(s) voltage (1 phase)	240	Voltage		Voltage
Fuel tank capacity (hrs @ 100% load)	**	Hours		Hours
Type (Sub-base/Remote)	**	-		-
Main Breaker Maximum Rating	800	Amps		Amps
Trip Features Per Spec	LSI	-		-
Interrupt Rating	42	KAIC		KAIC
Load Bank (Radiator Mounted, None)	None			
Load Bank Rating Percentage		% of FLA		
Enclosure type (Sound Atten., Weatherproof, None)	75 dB Sound Attenuating			

** Sized per manufacturer recommendations to meet intent of plans and specifications, codes, and environmental conditions at location of installation. Please highlight any deviations from drawings and specifications.

END OF SECTION

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PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall supply the automatic transfer switch (ATS) as specified herein.
- B. The ATS scope of work includes:
 - 1. Providing and installing one automatic transfer switch of rating shown on Contract Drawings.
 - 2. Submittal data and drawings.
 - 3. Startup assistance.
 - 4. Factory and field testing.
 - 5. Operation and maintenance manuals.
 - 6. Warranty of all components.
- C. Startup and configuration of ATS with installed voltages and loads.
- D. As required under Electrical Specifications [Factory and Field Testing], furnish all required labor, materials, safety equipment, transportation, test equipment, incidentals and services to perform factory and/or field testing.

1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Electrical Specifications [Factory and Field Testing]
- C. Project Drawings

1.03 SUBMITTALS REQUIREMENTS

- A. Provide Submittals as specified in Electrical Specifications [Electrical General, Submittal Requirements].
- B. Include a record of each parameter available to be changed by the user. The list shall include factory defaults and space for entered values.

1.04 OPERATION AND MAINTENANCE INFORMATION

- A. Provide operation and maintenance information as specified in Electrical Specifications [Electrical General, Operating and Maintenance Information].
- B. Include a record of each ATS parameter setup during startup and testing and place a copy of setting in each O & M manual.

PART 2 PRODUCTS

2.01 AUTOMATIC TRANSFER SWITCH

- A. General:

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1. The ATS 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. ATSs 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. The ATS shall be rated to close on and withstand 42,000 RMS symmetrical short circuit amperes at the ATS terminals or otherwise shown. Provide overcurrent protection as shown on the Contract drawings.
 3. The ATS 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.
 4. ATS types utilizing components of molded case circuit breakers, contactors, or parts thereof, are not acceptable.
 5. The switch assembly shall be installed in a NEMA enclosure located as shown on Contract drawings.
 6. The automatic transfer switch shall be an ASCO Model 7000, Zenith ZTSD, each with options to meet specified requirements, or equal.
- B. Switch Unit:
1. The transfer switch unit shall be electrically operated and mechanically held. The electrical operator shall be solenoid operated and only momentarily energized to minimize power consumption and heat generation.
 2. The transfer switch shall feature a delayed transition mode. The switch shall remain in the neutral position (neither emergency nor normal) until the associated time delays have expired and allow the switch to complete the transfer.
 3. The switch shall be 3 pole double throw with inherently interlocked construction. A solid neutral shall be provided for all systems.
 4. Wide contact gaps shall be provided to insure positive isolation of the normal and emergency power sources.
 5. The switch shall be fully rated for amperage shown on Contract Drawings, for switching all types of loads including induction motors. The ratings shall apply to the voltage and mounting arrangement as shown in the drawings.
 6. The main power contacts shall have silver alloy contact construction featuring a wiping action each time the switch is operated. Arc chutes shall be utilized to contain the inherent spark created when switching under load.
 7. The main contact design shall allow repeated making and breaking of rated full load current, with a combination of motor and other loads and without damage or undue wear to the contacts.
 8. All main power contacts and auxiliary contacts shall be mechanically driven from a common actuator shaft.
 9. The bus shall be constructed of silver plated copper.
 10. Inspection of all contacts, linkages and moving parts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors.
 11. All switch and relay contacts, coils, mechanical linkages, and control elements shall be serviceable or removable from the front of the mounted switch or accessory assembly without removal of the switch or assembly from the compartment and without disconnection of the power cables or control wiring.
 12. The switch shall have a manual operating handle for maintenance purposes.
 13. Compression screw type solder-less terminals or lugs shall be provided for connecting all external line & load power cables and control wiring. All connections shall be accessible from the front without removal of internal components.

14. A terminal strip shall be provided for terminating all control wiring. All terminals shall be numbered with machine printed lettering matching the wire number of the terminated wire.
15. All control wiring shall have permanent identification at each point of connection. Wire identification shall be by machine printed numbered wiring sleeves. Electrically common wires shall have the same wire number. Electrically different wiring shall have unique wire numbers.
16. Control wiring shall be neatly bundled and secured in place by plastic cable ties. Wiring shall be protected with plastic spiral wrap where it crosses over a hinge to the door.

C. ATS CONTROL PANEL

1. A control panel shall be provided to direct the operation of the transfer switch. The modules sensing and logic shall be controlled by a built in microprocessor. Control panels that do not utilize microprocessor electronics to control the operation of the switch are not acceptable.
2. 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.
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.
 - a. Sensing and control logic shall be provided on multi-layer printed circuit boards.
 - b. The panel shall be enclosed with a protective cover and be outer door or deadfront mounted such that it may be operated with the door closed for safety and ease of maintenance.
4. 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%.
 - a. The under-voltage of each phase of the normal source shall be monitored, with pickup adjustable from 85% to 100% of nominal and the dropout adjustable from 75% to 98% of pickup setting, both in increments of 1%. These adjustments shall be factory set at 85% dropout, and 90% pickup.
 - b. The voltage of each phase of the emergency source shall be monitored, with pickup adjustable from 85% to 100% of nominal. This adjustment shall be factory set at 95% pickup.
 - c. Frequency sensing of the emergency source shall be provided, with pickup adjustable from 90% to 100% of nominal. This adjustment shall be factory set at 97% pickup.
 - d. The control panel shall meet or exceed the voltage surge withstand capability in accordance with IEEE Standard 472 1974 (ANSI C37.90a 1974) and the withstand voltage test in accordance with the proposed NEMA Standard ICS1 109.21.
5. The transfer switch control panel shall be capable of operating over a temperature range of -20 to +60 degrees C.
6. The transfer switch shall be provided with advanced inphase algorithm which measures the frequency difference between the two sources and initiates transfer at appropriate phase angles to minimize disturbances from transferring motor loads.
7. The control panel shall include the following field adjustable time delays:

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- a. Time delay to override momentary normal source outages, adjustable from 0 to 5 minutes. This adjustment shall be field set to place emergency generator on-line in 1 minute.
- b. Transfer to emergency time delay for controlled timing of load transfer to emergency, adjustable from 0 to 5 minutes. This adjustment shall be field set switch position in 5 seconds after power has stabilized.
- c. Emergency source failure time delay to ignore momentary transients during initial generator set loading, adjustable from 0 to 6 seconds. Set at 2 seconds.
- d. Retransfer to normal time delay, adjustable 0 to 60 minutes. This adjustment shall be factory set at 5 minutes. The time delay is automatically bypassed if the emergency source fails and normal source is acceptable.
- e. Unloaded running time delay for emergency engine generator cooldown, adjustable from 0 to 60 minutes. This adjustment shall be factory set at 5 minutes.
- f. Delayed transition time delay for setting the dead time when all power is removed from the load side of ATS, adjustable 0 to 5 minutes. Set at 1 minute.
- g. Generator Exercise Timer: Timer provided for operator adjustment of day of week, time of day and run duration for exercising the generator under operating loads by activating the automatic transfer switch. . Timer shall be mounted on the ATS outer deadfront door.
- h. The controller shall provide an integral engine exerciser. The timer shall be field set by the Contractor with date and time during training. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:
 - 1) Enable or disable the routine.
 - 2) Enable or disable transfer of the load during routine.
 - 3) Set the start time of day, day of week, week of month, alternate or every time start, duration of run.
 - 4) At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.
8. The controller shall commit to start engine which requires the engine to reach proper output and run at least the duration of the cooldown setting, regardless of whether the load is transferred.
9. Provide interface relays or main switch follower contacts to comply with I/O interface requirements as defined in the P&ID diagram. Interfacing relays shall be industrial grade plug-in type with dust covers. Interface connections shall be wired to backpan terminal blocks. At minimum, the switch shall have the following unused I/O contacts available:
 - a. Switch in Normal – SPDT rated 10 amps, 120 VAC
 - b. Switch in Emergency – SPDT rated 10 amps, 120 VAC
 - c. Engine starting contact -- DPDT gold-flashed contacts rated 10 amps, 32 VDC
 - d. Emergency Power available – SPDT rated 10 amps, 120 VAC
 - e. Normal Power available – SPDT rated 10 amps, 120 VAC
10. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal.
11. Provide separate LED signal lights with nameplates indicating the following:

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- a. Utility power is available (green)
 - b. Generator power is available (red)
 - c. ATS is connected to Utility source (green)
 - d. ATS is connected to the Generator source (red)
 - e. ATS in neutral position (wht)
12. A three position momentary-type test switch shall be provided for the test / automatic / reset modes:
- a. Test: simulate normal source failure
 - b. Automatic: normal operation
 - c. Reset: bypass the time delays on either transfer to emergency or retransfer to normal.
13. All adjustments shall be field adjustable without the use of tools, meters, power supplies, or special test equipment and can be made safely without personal exposure to live parts
14. Each adjustment resolution shall be settable within minimum increments of 1%.
15. Repetitive accuracy of timer, voltage and frequency settings over a temperature range of -20° C to 70° C shall be within +/- 2%.
16. The control panel programming shall be lockable via password protection.
17. The wire harness for connection of the control panel to the transfer switch shall have sufficient length to reach between the mounting locations shown on the Contract drawings.
18. Provide the following displays on the controller:
- a. Event log to display 99 logged events with the time and date of the event, event type and event reason.
 - b. Total number of ATS transfers.
 - c. Number of ATS transfers caused by power source failures.
 - d. Total number of days ATS has been in operation.
 - e. Total number of hours that the normal and emergency sources have been available.

PART 3 EXECUTION

3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

3.02 FIELD ASSISTANCE

- A. Testing, checkout and start-up of the ATS equipment shall be performed under the technical direction of a factory trained authorized manufacturer representative.
 - 1. The setup and programming of the ATS shall be provided by a factory-trained representative who is authorized by the ATS manufacturer to perform the startup. This setup and programming shall be done prior to and during the first application of power.
 - 2. Provide testing as specified in Electrical Specifications [Factory and Field Testing].
- B. Provide 1 hour of "ATS Setup" Training on operating and maintenance procedures.

3.03 WARRANTY

- A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

END OF SECTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This section applies to specifies switchboards rated 600 volts and below.
- B. Provide Switchboard(s) (SWBD) as specified herein and shown on the Drawings.
 - 1. The System Integrator shall perform and be responsible for procurement, submittals, shop drawings, interconnection drawings, factory testing, and all control wiring for the SWBD. System Integrator is defined in Electrical Specifications [Electrical General].
- C. All wiring, wire color codes, wire labeling and terminal blocks within SWBD shall be as specified in Electrical Specifications [Low Voltage Wire & Data Cable].
- D. The SWBD scope of work includes:
 - 1. Providing SWBD structure and all internal components.
 - 2. Installation of the SWBD on concrete pad per details.
 - 3. Submittal data and drawings.
 - 4. Startup and configuration of SWBD internal components.
 - 5. Factory and field testing.
 - 6. Operation and maintenance manuals.
 - 7. Warranty of all components.
 - 8. Seismic Anchorage Design Calculations and conforming installation.
 - 9. Conduit – support systems, wire, and grounding system, for equipment interconnection, and operation.
 - 10. System calibration, testing and documentation.
- E. Electrical Specifications [Factory and Field Testing]. Furnish all required labor, materials, safety equipment, transportation, test equipment, incidentals and services to perform factory and/or field testing.
- F. All electrical equipment and materials, and methods - including installation, calibration, and testing - shall conform to the applicable codes and standards listed in this and other Sections. All electrical materials and work shall conform to published standards of the National Electric Code (NEC), Institute of Electrical and Electronic Engineers (IEEE), and Underwriters Laboratories Inc (UL).

1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Electrical Specifications [Low Voltage Wire & Data Cable]
- C. Electrical Specifications [Automatic Transfer Switch]
- D. Electrical Specifications [Panelboard and Power Transformer]
- E. Electrical Specifications [Factory and Field Testing]

1.03 SUBMITTALS REQUIREMENTS

- A. Provide Submittals as specified in Electrical Specifications [Electrical General, Submittal Requirements].
- B. Include a record of each configurable parameter available to be changed by the user for internal components. The list shall include factory defaults and space for entered values for each configurable component.

1.04 OPERATION AND MAINTENANCE INFORMATION

- A. Provide operation and maintenance instructions as specified in Electrical Specifications [Electrical General].

PART 2 PRODUCTS

2.01 SWITCHBOARD

- A. General:
 - 1. The Switchboard shall be Eaton Pow-R-Line, Square D, or approved equal.
 - 2. The Switchboard (SWBD) shall be built and tested in accordance with:
 - a. NEMA Standards
 - b. ANSI
 - c. Underwriters Laboratories, Inc.
 - 3. Switchboard enclosure shall be NEMA rated as shown in the drawings.
- B. Metering Panel:
 - 1. Provide metal enclosed, front accessible, self contained utility metering panel. Voltage, phase, AIC and continuous amperage rating shall be as shown on Contract Drawings. Panel will include meter socket, factory installed main breaker(s) and test by-pass facility.
 - 2. Design utility entrance and termination and other features per NEC, local codes, and serving Utility requirements.
 - 3. Enclosure shall be NEMA 3R construction for underground utility service. Enclosure shall be manufactured from galvanized 16 ga. (min) sheet steel. The enclosure shall be finished with ANSI 61 gray enamel paint. Provide pad mount, surface mount or flush mount cabinet per installation detail.
 - 4. Utility metering switchboard shall be Cutler Hammer Pow-R-Line or equal.
- C. Switchboard:
 - 1. Switchboard shall be front accessible with group mounted, buss connected circuit protective devices. Where provisions for future circuit protective devices are required, space for the device, corresponding vertical buss, device connectors and the necessary mounting hardware shall be supplied.
 - 2. Distribution section shall meet all requirements per NEC, local codes, and as defined in the drawings.
 - 3. Buss shall be copper. Aluminum buss is not equal to copper buss. Furnish buss mounted cable lugs sized for cabling that is required to be directly buss connected.
 - 4. Buss shall, 3 phase, 4 wire, 480 volt, 65,000 AIC minimum symmetrical (or as shown otherwise in the drawings).
 - 5. Power buss:

- a. Continuous amperage rating at least equal to the main circuit breaker or the power source and shall be braced to withstand stresses resulting from the maximum short-circuit current available.
 - b. Horizontal bus shall extend through all sections of the switchgear unless shown otherwise in the drawings with vertical connections to circuit breakers in each section.
 - c. Buss shall be mounted on heavy-duty insulated glass polyester supports, and main bus joints shall be bolted using a minimum of two bolts.
 - d. Shipping splits and provisions for future bus extensions shall have tin-plated bolted connections.
6. Neutral bus, when specified or required, shall have the same capacity as the main bus.
 7. Ground buss shall be rated per NEC relative to the power buss amperage rating and shall extend the entire length of the switchboard.

2.02 MOLDED CASE CIRCUIT BREAKERS

A. General

1. Circuit breakers and motor circuit protectors shall be manufactured by Eaton Cutler-Hammer, Square D, G.E., Siemens, or equal.
2. Circuit breakers shall be the bolt-on type.
3. Multiple pole circuit breakers shall be designed so that an overload on one pole automatically causes all poles to open. The use of tandem or dual circuit breakers in a normal single pole space to provide the number of poles or spaces specified are not acceptable.
4. Molded case circuit breakers shall be operated by a single toggle-type handle and shall have a quick-make, quick-break switching mechanism. An automatic trip of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and have flash reduction arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
5. Minimum interrupting capacity:
 - a. 480 volt circuit breaker shall have a minimum interrupting capacity of 42,000 amperes.
 - b. 120 or 208 or 240 volt breaker shall have a minimum interrupting capacity of 22,000 amperes
6. Circuit breakers shall be UL listed for series application.
7. Where indicated circuit breakers shall be current limiting.
8. Where indicated on Drawings, provide UL listed circuit breakers for continuous duty at 100% of their ampere rating in the intended enclosure.
9. Furnish add-on features such as auxiliary position status contacts, trip indication contacts, zone interlocking, shunt trip coils, etc, as shown in the drawings.

B. Trip Unit – Molded Case Circuit Breakers

1. Circuit Breakers over 400 volt and over 90A trip units as defined herein. All other circuit breakers shall have shall have non-electronic thermal-magnetic (TM) trip units with inverse time-current characteristics.
2. The trip unit shall be Eaton type Power Expert Release (PXR) or equal.
 - a. Each circuit breaker trip unit shall have three (3) current sensors, voltage sensors, microprocessor, and flux transfer trip solenoid at minimum.
 - b. Trip units shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.

- c. Trip units shall be powered from the primary voltage connected to the circuit breaker. Current flow shall not be required for settings functions. Circuit breaker trip units shall be operable and adjustable with zero current flowing through the circuit breaker.
 - d. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current and voltage sensors, and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time-delay settings are reached.
 - e. Trip units shall be provided with a display panel. Trip units shall have an information system that provides LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip
 - f. Programming may be done via a keypad at the faceplate of the unit. Programming via the communication network if or as shown in drawings.
 - g. The trip unit shall offer a three-event trip log that will store the trip data, and shall time and date stamp the event.
 - h. The trip unit shall have the following advanced protective features integral to the trip unit:
 - 1) Adjustable undervoltage release (defeatable)
 - 2) Adjustable overvoltage release (defeatable)
 - 3) Reverse power and fault current
 - 4) Reverse sequence voltage
 - 5) Under-frequency
 - 6) Over-frequency
 - 7) Voltage phase unbalance and phase loss during current detection.
 - i. Although not preferred but if needed, furnish 24VDC redundant power supply with terminal blocks and 0.5A miniature circuit breakers to distribute control power to each circuit breaker trip unit that requires it for settings. The power supply shall be connected below the main breaker and transfer switch but above any feeder circuit breakers. Provide option for external power supply input.
3. System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:
- a. Adjustable long-time setting (set by adjusting the trip setting dial to an amount not to exceed rating plug)
 - b. Adjustable short-time setting and delay with selective flat or I²t curve shaping,
 - c. Adjustable instantaneous setting
 - d. Adjustable ground fault setting and delay with selective flat or I²t curve shaping.
4. The microprocessor-based trip unit shall have both powered and unpowered thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.
5. Furnish internal ground fault protection with adjustable settings. Provide neutral ground fault sensor for four-wire loads. Bypass neutral sensor for 3 wire loads.
6. Include ARMS technology for all circuit breakers 400A and above or where shown on drawings.
- a. Activation and deactivation of the ARMS technology and local indication shall be accessible from the face of the trip unit without opening the circuit breaker door or cover and exposing operators to energized parts.

- b. Recalibration or adjustment of trip unit parameters shall not be required when enabling / disabling the ARMS technology.
- 7. Breakers shall have built-in test points for testing the long-time delay, instantaneous, and ground fault functions of the breaker by means of a test set.

C. Manual operators

- 1. Furnish door interlocked manual operators for mains and selected feeder circuit breakers as shown in the drawings.
- 2. Manually operated mechanisms designed to open, close and reset circuit breakers.
- 3. Operators shall be available in three basic configurations— flange mounted, through-the door rotating and direct handle through door to provide a variety of options for different applications and enclosure ratings.

2.03 ACCESSORIES

A. Space Heaters:

- 1. Outdoor rated switchgear shall be provided with 120 volts AC thermostatically controlled space heaters. Heater wiring shall be to terminal blocks for connection to external power source. One heater shall be provided in each vertical breaker section. Heaters shall have guards to prevent accidental contact with power or control wiring.

B. Key Interlocks:

- 1. Key interlocks shall be provided as shown on the drawings. The switchgear manufacturer shall be responsible for coordinating interlocks for switchgear main circuit breakers interlocked with generator circuit breakers. Key interlocks shall be as manufactured by Kirk Key Interlock Company, or equal.

C. Surge Protective Device (SPD)

- 1. SPD shall be suitable Service entrance location per ANSI/IEEE C62.41, IEEE C62.45, and UL1449 3rd edition and tested according to IEEE C62.44 as Secondary Surge Arrestor.
- 2. Unit shall be sealed and not allow vapors from entering the switchboard enclosure after a voltage surge event.
- 3. Modes of protection – Line to Line, Line to Ground, Line to Neutral (as applicable). Voltage, phase and neutral connections per one-line diagram. Current surge capacity shall be as shown in the drawings or, if not shown, 100,000 amps per mode minimum
- 4. The SPD shall be factory installed inside the switchboard during assembly by the original equipment manufacturer. The OEM design shall be integral to the design of the switchgear with special paneling and cutouts specifically designed for unit mounting.
- 5. The SPD connections shall be located as close as possible to the load side of main disconnect device and ground/neutral bar.
- 6. The SPD shall have integral 30-amp disconnect and fuses. Service of the SPD assembly, fuses or other serviceable components shall be from front access of the switchboard and shall not require disassembly of switchboard panels to repair or replace parts.
- 7. SPD shall be Cutler-Hammer Clipper, Current Technology TransGuard or equal.

D. Power Monitor:

- 1. General:
 - a. Microprocessor based multifunction power and energy meter

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- b. Designed for multifunction electrical power, voltage, and current measurement on 3 phase power systems.
 - c. Measured parameters: voltage, current, frequency, unbalance, kW, KVAR, KVA, power factor, kWh.
 - d. Support for 3-Element Wye, 2.5 Element Wye, 2 Element Delta, 4 wire Delta systems.
 - e. 200 ms update for power measurement, 100ms update for voltage, current, Hz.
 - f. Din rail mounting
 - g. 85 to 264 VAC control power, 5W.
 - h. Furnish compatible current transformers with ratio as shown in the drawings or as needed to measure full feeding circuit breaker rated current.
2. Voltage Inputs
- a. Configurable to potential transformer ratio.
 - b. Input impedance of 1 Mega Ohm, 0.014W at 120 Volts.
 - c. Direct voltage input range
 - 1) 347 Volts Line to Neutral
 - 2) 600 Volts Line to Line.
 - d. 2500V withstand.
3. Current Inputs:
- a. Configurable to current transformer (CT) ratio 1A or 5A input.
 - b. Burden 0.05VA, Impedance 0.002 ohms
 - c. Meter shall have a maximum burden of 0.005VA per phase, at the maximum of 15 Amperes continuous input.
 - d. Fault current withstand shall be 200 Amps for 1/2 second.
4. Digital I/O:
- a. Two status inputs 24VDC, dry contact.
 - b. One KYZ output, 24VDC, 30mA
5. Accuracy
- a. Revenue meter accuracy
 - b. +/- 1% or better for volts and amps
 - c. +/- 1% for power and energy functions.
 - d. True RMS measurements
6. Communications
- a. Ethernet - 100BaseT Ethernet IP Allen Bradley protocol
 - b. Modbus TCP
7. Acceptable Products
- a. Allen Bradley PM1000 1408-EM3A-ENT Ethernet
 - b. Or Equal
- E. Voltage Transformer
- 1. Three phase voltage transformers consisting of an assembly of three transformers in one case. The core and coil assembly is encased in a thermoplastic shell and filled with resin.
 - 2. Primary: 3 phase wye with neutral (neutral left open unless system is grounded).
 - 3. Secondary: 3 phase wye grounded neutral
 - 4. Primary current limiting fuses, 200kA interrupting capacity, KTK—R type or equal.
 - 5. Secondary fuses: BBS type or equal.
 - 6. Only ground N/n terminals if source is 3 phase, 4 wire effectively grounded.
 - 7. Burden 100 VA per phase at 55 deg C ambient.
- F. CT Shorting Terminal Block

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1. Panel mount inside control equipment with front screw terminal connections. Inserting a thumb screw shall short terminals to a top mounted ground bar. Provide quantity of terminal poles as required for function and as shown in Drawings. Furnish Flex Core 170xSC or equal.
- G. Current Transformers
1. Furnish mounted (preferable) or unmounted current transformers based on space allocated and installation requirements. The current transformer shall have wire leads or binding posts and ratio as shown on the Drawings. The accuracy shall be metering accuracy class 0.6 at a minimum burden at 60 hz shall be 2.5 VA and as required to meet specified accuracy of device(s) fed.

PART 3 EXECUTION

3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship] and as specified herein.

3.02 INSTALLATION

- A. Vertical sections shall be mounted on steel channel sills continuous on two sides. The steel channel sills shall be heavy duty to meet the specific seismic requirements of this project location. These sills shall be mounted on the concrete pad to be installed per the Contract Drawings.
- B. Conduit entering Switchboard shall be stubbed up 1" into the bottom horizontal wireway (typically) directly below the vertical section in which the conductors are to be terminated.
- C. Base of Switchboard shall be adequately grouted, caulked or sealed to prevent the entry of insects and rodents.

3.03 FIELD ASSISTANCE

- A. Provide field testing as specified in Electrical Specifications [Electrical General, Testing].

3.04 WARRANTY

- A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

END OF SECTION

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PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Labor, materials, equipment, tools, safety gear, test equipment, incidentals, services, and transportation for a complete electro-mechanical installation as shown on the Drawings, included in these Specifications, or as can be reasonably implied from project descriptions.
- B. The scope of work includes:
 - 1. Furnish and install grounding system required by Drawings, or if not shown or defined, as required by Article 250 of the NEC. Ground conductors shall be sized for the protective device, minimum.
 - 2. Furnish and install conduits, junction boxes, underground boxes, and associated hardware. Provide hardware, conduit, fittings, and other parts for a complete grounding installation.
 - 3. Installations shall be designed and installed with components meeting the NEMA area designation.
- C. Work includes that specified in Electrical Specifications [Electrical General].

1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Electrical Specifications [Low Voltage Wire & Data Cable]
- C. Project Drawings

1.03 QUALIFICATIONS

- A. Material furnished under this specification shall be installed by qualified installers meeting requirements specified in Electrical Specifications [Electrical General, Qualifications].

1.04 SUBMITTAL REQUIREMENTS

- A. Provide submittals and Drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].
- B. Submit manufacturer's product information for connections, clamps, rods, terminals, and grounding system components.

PART 2 PRODUCTS

2.01 GROUNDING SYSTEM

- A. General
 - 1. Grounding conductors shall be sized as shown on the Drawings or in accordance with NEC article 250, whichever is larger.

2. Components of the grounding electrode system shall be manufactured in accordance with UL 467 - Standard for Safety Grounding and Bonding Equipment.
- B. Grounding System
1. The utility service ground shall be tied to a building ground grid consisting of a "UFER" and/or ground rod type grounding system.
 2. Electrical Contractor shall design layout of ground system if one is not shown on drawings per requirements herein.
 3. The UFER shall consist of minimum 25 feet minimum of code sized bare copper wire conductor laid at 3 foot minimum depth encased with ground enhancement material or as detailed on the Contract Drawings. UFER ground shall be located where soil moisture content will be maximized. Terminate UFER ground at ground rod in inspection box.
 4. Ground enhancement material shall be permanent and be designed to lower earth resistance in all soil conditions. Once set, material shall have resistivity of not more than 20 ohm-cm resistance. Material shall be set by mixing it with water to form a slurry and shall not dissolve or decompose once cured. Ground enhancement material shall be Erico Ground Enhancement Material (GEM), Lyncole XIT, or equal.
 5. Utility services 1000A to 1600A: Provide 4 ground rods 12 feet apart minimum, connected together, and to UFER ground, and to the service panel with #4/0 bare copper ground wire. Connect ground system to switchboard ground bus in four places from ground rod inspection boxes.
 6. The ground bonding wire(s) from the ground rod(s) shall extend through and appropriately sized conduit into the electrical panel. Connect the ground wire(s) to the ground bus with readily visible UL approved "ground clamp" attached to the ground bus.
 7. Install bare copper ground bond wires from the UFER ground to the various locations shown on the Drawings.
- C. Raceway Grounds
1. Metallic conduits shall be assembled to provide a continuous ground path. Metallic conduits shall be bonded using insulated grounding bushings.
 2. Provide separate code size wire ground conductor for PVC conduits
- D. Equipment and Enclosure Grounds
1. Electrical and distribution equipment shall be connected to the grounding system. Cables shall be sized as specified.
- E. Components
1. Ground rod shall be copper-clad steel, ¾" x 10 ft length. Rods shall have minimum copper thickness of 10-mils. Provide threaded, sectional type with coupling and driving stud so that extension rods of same diameter and length may be added where necessary to obtain necessary ground resistance improvements. Couplings and driving studs shall be by the same manufacturer as the rod. Rods shall be Joslyn; Thomas & Betts; or equal.
 2. Provide ground well enclosures for all outdoor ground rods. Furnish Christy type F8, Christy N9, or Christy B1017 (traffic areas), marked "GROUND" or equal unless otherwise shown on the Drawings.
 3. Ground rod clamps shall be bolt-on type as manufactured by O-Z Gedney type GRC, or equal.
 4. Every piece of equipment shall be grounded per NEC.

5. Each electrical enclosure shall have a copper ground bus. Screw type fasteners shall be provided on all ground busses for connection of grounding conductors. Ground bus shall be a Challenger GB series, ILSCO CAN series or equal.

PART 3 EXECUTION

3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in specified in Electrical Specifications [Electrical General, Workmanship].

3.02 INSTALLATION

- A. Grounding System:
 1. Install all products per Electrical Specifications [Electrical General, Installation].
 2. Each nonmetallic conduit shall contain a code sized grounding conductor.
 3. The system neutral conductor and all equipment and devices required to be grounded by the National Electrical Code shall be grounded in a manner that satisfies the requirements of the National Code.
 4. The system neutral (grounded conductor) shall be connected to the system's grounding conductor at only a single point in the system. This connection shall be made by a removable bonding jumper sized in accordance with the applicable provisions of the National Electrical Code if the size is not shown on the Drawings. The grounding of the system neutral shall be in the enclosure that houses the service entrance main overcurrent protection.
 5. Utilize mechanical connections in accessible locations and exothermic connections in non-accessible or buried locations.
 6. The secondary on all transformers shall be grounded.
 7. All raceway systems, supports, enclosures, panels, motor frames, and equipment housings shall be permanently and effectively grounded.
 8. Install insulated grounding conductor with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards and distribution panels with 12ga. conductor to grounding bus
 9. All receptacles shall have their grounding contact connected to a grounding conductor.
 10. Branch circuit grounding conductors for receptacles or other electrical loads shall be arranged such that the removal of a lighting fixture, receptacle, or other load does not interrupt the ground continuity to any other part of the circuit.
 11. Attachment of the grounding conductor to equipment or enclosures shall be by connectors specifically provided for grounding. Mounting, support, or bracing bolts shall not be used as an attachment point for ground conductors.
 12. Install grounding electrode conductor and connect to reinforcing steel in foundation footing. Electrically bond building steel to ground system. Bond metal siding not attached to grounded structure.

3.03 FIELD QUALITY CONTROL

- A. Inspections:
 1. Ground system shall be inspected prior to cover.

- B. Testing:
1. Complete applicable test forms if provided in testing specifications [Factory and Field Testing]. If form is not provided, furnish results on a vendor standard form.
 2. Test each grounding connection to determine the ground resistance. The grounding test shall be IEEE 81.2 and NETA 7.13. The current reference rod shall be driven at least 100 feet from the ground rod or grid under test. The measurements shall be made at 10-foot intervals beginning 20 feet from the test electrode and ending 80 feet from it, in direct line between the ground rod or center of grid and the current reference electrode. Investigate ground resistance in excess of 1 ohm and revise or install new or additional ground electrodes as needed to reduce point to point resistance to less than 1 ohm.

END OF SECTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall supply panelboards and power transformers as specified herein and as shown in the Contract Drawings.
- B. The Contractor shall perform complete startup and testing services for the panelboard and power transformer per Electrical Specifications [Factory and Field Testing].
- C. Work includes that specified in Electrical Specifications [Electrical General].
- D. Reference drawings for panelboard and transformer location – electrical structures or stand-alone. If within electrical structures, the Contractor shall supply the electrical section with factory installed panelboard and transformer. If stand-alone, the Contractor shall install individual components with enclosures as specified herein.
 - 1. The quantity of breakers with size and number of poles as shown on panelboard schedules.
 - 2. Submittal data and drawings.
 - 3. Nameplates (denoting name/tag and as required by code)
 - 4. Startup assistance.
 - 5. Panelboard testing.
 - 6. Operation and maintenance manuals.
 - 7. Warranty of all components of the panelboard and power transformer.

1.02 SUBMITTAL REQUIREMENTS

- A. Provide submittals and drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].
- B. Provide ratings and characteristics including voltage, temperature rise, KVA, efficiency, materials of construction, NEMA enclosure rating, voltage taps, and impedance.
- C. Provide catalog cuts for circuit breakers and devices.
- D. Submit panelboard schedule for approval.

1.03 OPERATION AND MAINTENANCE INFORMATION

- A. Provide operating instructions as specified in Electrical Specifications [Electrical General, Operating and Maintenance Instructions].

PART 2 – PRODUCTS

2.01 PANELBOARDS

- A. General
 - 1. The Contractor shall furnish panelboards of a type indicated on the one-line Contract drawings and specified herein.
 - 2. Furnish and install padlock lock-off attachment for each circuit breaker.

3. Panelboards shall comply with the applicable sections of UL, NEC, and NEMA and shall be Cutler Hammer Pow-R-Line, Square D, ITT or equal.
4. A machine-typed circuit directory with clear plastic cover shall be supplied mounted on the inside of door in a frame when equipment is shipped. Circuit directory shall be as approved in the Submittal.

B. Interiors

1. Interiors shall be completely factory assembled with bolt-on devices.
2. Main and feeder breakers shall include lockout padlock hasp suitable for frame size. Provide Cutler Hammer QLPB123PL, PLK1, or similar.
3. Full size insulated neutral bars shall be included. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
4. Main bus bars shall be plated copper sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 50 degrees C above an ambient 40 degrees C maximum.
5. A copper ground and neutral bus shall be included in all panelboards with terminal screws.

C. Boxes

1. Provide minimum gutter space in accordance with the National Electric Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.

D. Trims

1. Provide a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a catch, lock and trim.
2. Surfaces of the trim assembly shall be properly cleaned, primed and a finish coat of gray ANSI 61 or 49 or to Switchboards and MCCs.
3. Surface trims shall be same height and width as box for surface mount, and 3/4" (min) beyond box on all sides for flush mount.

E. Panelboard Ratings

1. Panelboards shall have voltage, phase and short circuit (AIC) ratings as shown on the drawings.
2. Breakers shall be a minimum of 100 ampere frame. Breakers 15 through 100 amperes trip size shall take up the same pole spacing.
3. Panelboards shall be labeled with a UL short circuit rating. When series ratings are applied with integral or remote upstream devices, a label shall be provided. Series ratings shall cover all trip ratings of installed frames. It shall state the conditions of the UL series ratings including:
 - a. Size and type of upstream device
 - b. Branch devices that can be used
 - c. UL series short circuit rating

2.02 POWER TRANSFORMER

- A. The power transformer shall be ventilated dry type. Voltage and KVA ratings shall be as shown on the Contract Drawings. The transformer shall be as manufactured by Cutler Hammer, Jefferson, ACME, Square D, G.E., or equal.
- B. Transformer shall meet latest DOE 2016 minimum efficiency standards.

- C. Coils shall be manufactured of electrical grade aluminum (if stand-alone) or copper (if within a MCC or Switchboard) and shall be adequately braced for short circuit ratings and defined in ANSI and NEMA standards.
- D. Transformers rated 31KVA and above shall have two 2½ percent taps above and below normal full capacity (ANFC and BNFC).
- E. The transformer shall carry full load continuously at rated voltage and frequency without exceeding the average temperature rise of 115°C above an ambient temperature of 40°C. Insulation shall be rated for 220°C (UL class 220°C).
- F. Impedance (Z): 4.0% +/- 0.3% or above to keep downstream fault currents to a minimum.
- G. Low noise. For transformers installed within electrical equipment, vibration isolators shall be installed between the transformer and its mounting surface to reduce case vibration and associated noise.
- H. For stand alone transformers, the transformer housing shall be securely fastened to the mounting surface with bolted connections sized appropriately to withstand seismic zone 4 forces.
- I. The transformer shall be finished with two coats of enamel to resist rust and corrosion.
- J. Transformers located inside electrical structures or enclosures shall be provided with adequate ventilation for heat removal as required.
- K. Transformer neutral shall be grounded in accordance with Article 250-26 and 450-10 of NEC and any applicable local ordinances. Installation and protection of the transformer grounding conductors and attachments shall be per NEC 250-24.

PART 3 – EXECUTION

3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].
- B. Perform work to remedy non-compliant installations after inspection.

3.02 INSTALLATION

- A. Provide installation as recommended by the manufacturer and as specified in Electrical Specifications [Electrical General, Installation].

3.03 FIELD ASSISTANCE

- A. Provide testing as specified in Electrical Specifications [Factory and Field Testing].

3.04 WARRANTY

- A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

END OF SECTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide each variable frequency drive as shown on elementary and one-line Drawings. Variable frequency drive shall be provided with full speed bypass, harmonic conditioner, line and/or load reactor, RFI filter and/or other accessories where shown on The Drawings. All VFDs shall be of the same manufacturer.
 - 1. The System Integrator shall perform and be responsible for procurement, submittals, shop drawings, testing, and all control wiring for the VFD. System Integrator is defined in Electrical Specifications [Electrical General].
- B. Provide enclosure (and side mounted wire chase as required) for top or bottom feed conduit connection as shown in the Drawings. Enclosure size shall not exceed the space allocated in the Drawings for such use.
- C. Provide cooling/ventilation system, mounting hardware, associated components, devices, and field control stations. Some components may be specified in other Electrical Specifications such as terminal blocks, wire, buttons, etc.
- D. Installation of the VFD with components as specified in Electrical Specifications [Electrical General]. The VFD scope of work includes:
 - 1. Providing and installing VFD(s) of rating shown on The Drawings.
 - 2. Submittal data and drawings.
 - 3. Startup assistance.
 - 4. Factory and field testing.
 - 5. Operation and maintenance manuals.
 - 6. Warranty of all components.
- E. Startup and configuration of VFD with actual motor load.
- F. Electrical Specifications [Factory and Field Testing]. Furnish all required labor, materials, safety equipment, transportation, test equipment, incidentals and services to perform factory and/or field testing.

1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Electrical Specifications [Low Voltage Wire & Data Cable]
- C. Electrical Specifications [Factory and Field Testing]

1.03 SUBMITTALS REQUIREMENTS

- A. Provide Submittals as specified in Electrical Specifications [Electrical General, Submittal Requirements].
- B. Include a record of each VFD parameter available to be changed by the user. The list shall include factory defaults and space for entered values.

1.04 OPERATING AND MAINTENANCE INFORMATION

- A. Provide operation and maintenance instructions as specified in Electrical Specifications [Electrical General].
- B. Include a record of each VFD parameter setup during startup and testing and place a copy of setting in each O & M manual.

PART 2 PRODUCTS

2.01 GENERAL

- A. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection, and continuous or intermittent operation. All equipment shall be adequately stayed and braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details. All components and devices installed shall be industrial grade and shall be of sturdy and durable construction suitable for long, trouble-free service. Light duty, fragile, and competitive grade devices of questionable durability shall not be used.
- B. The VFD is inclusive of the input stage, buss, output stage, input filters, output filters, and all other assemblies, boards, or conditioning equipment, that make up the entire VFD system. The VFD system is herein referred to simply as "VFD" and is not to be parsed in any way to meet a specification as a specific part or assembly where it cannot be met as a system.
- C. Products that are specified by manufacturer, trade name, or catalog number establish a standard of quality and do not prohibit the use of equal products of other manufacturers provided they are favorably reviewed by the Owner and/or Engineer prior to installation.
- D. Underwriter's Laboratories (UL) listing is required for all substituted equipment when such a listing is available for the first named equipment.

2.02 QUALITY

- A. All equipment and materials shall be new and the products of reputable suppliers having adequate experience in the manufacture of these particular items. For uniformity, only one manufacturer will be accepted for each type of product.
- B. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection, and continuous or intermittent operation. All equipment shall be adequately stayed and braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, and shall be of sturdy and durable construction suitable for long, trouble-free service. Light duty, fragile, and competitive grade devices of questionable durability shall not be used.

- C. Products that are specified by manufacturer, trade name, or catalog number establish a standard of quality and do not prohibit the use of equal products of other manufacturers provided they are favorably reviewed by the Owner and/or Engineer prior to installation.
- D. Underwriter's Laboratories (UL) listing is required for all substituted equipment when such a listing is available for the first named equipment.

2.03 VARIABLE FREQUENCY DRIVE

- A. This specification is based on ABB ACS (standard harmonic ACS-550), Allen Bradley PowerFlex 755T or equal.
- B. The VFD shall be of the latest technology used to control and maintain a process variable (level, flow, pressure, speed, etc.) by varying the motor speed. The VFD shall be available from a single manufacturer in the horsepower range of 1 to 500 HP.
- C. Performance Requirements
 - 1. Harmonic Attenuation (applies to 6 pulse drives as shown in Drawings)
 - a. First order harmonic mitigation shall be provided in the form of DC choke or Line Reactor for all installations. An internally mounted AC line reactor or DC choke shall be provided to reduce input current harmonic content, provide protection from power line transients such as utility power factor correction capacitor switching transients and reduce RFI emissions.
 - b. Provide a DC choke to mitigate harmonics and provide equivalent to 5% impedance. A 5% impedance DC choke may be provided in lieu of a line reactor.
 - c. If the provided DC choke cannot provide an equivalent 5% input impedance, then an external 5% line reactor shall be provided.
 - 2. Open loop static speed regulation shall be 0.5 % to 1% of rated motor speed. When motor speed feedback is provided from a suitable encoder, closed loop speed regulation shall be 0.1% of motor nominal speed. Dynamic speed accuracy shall be less than 1%-sec with 100% torque step open loop and 0.5%-sec closed loop with 100% torque step. 2. Torque control response time shall be less than 10 ms with nominal torque. In the torque regulating mode, torque regulating accuracy open loop shall be +/- 5%; torque regulating accuracy closed loop shall be +/- 2%;
- D. Ratings
 - 1. The VFD shall employ a full wave rectifier to prevent input line notching and operate at a fundamental (displacement) input power factor of 0.98 at all speeds and nominal load.
 - 2. The VFD efficiency shall be 97.5% or better at full speed and load. Efficiency is defined as the output power divided by the input power in terms of percentage. All internal system losses recognized.
 - 3. Load The VFD shall be designed to continuously operate the following motor/pump load:
 - a. Motor NEMA design B, squirrel-cage induction or specialty specific use motor per Mechanical Division Specification as shown in Drawings.
 - b. Horsepower at full speed R.P.M. of submitted/approved motor.
 - c. Voltage, 230/460 VAC, three phase, 60 Hz.
 - d. Service factor, 1.15 S.F.
 - 4. Input Power The VFD shall be rated to continuously operate under the following input power conditions:

- a. The Drive shall be rated to operate from 3-phase power at nominal voltage (208VAC to 600VAC, +10% /-15% as shown in Drawings), 48Hz to 63Hz.
 - b. The overvoltage trip level shall be a minimum of 30% over nominal, and the undervoltage trip level shall be a minimum 35% under the nominal voltage.
 - c. Three phase, phase rotation insensitive.
 - d. Displacement power factor, 0.95 lagging at all loads and speeds above 10% rated load.
5. Output Power The VFD shall be rated to continuously operate while providing the following output power conditions:
- a. Voltage, 0 to 500 VAC.
 - b. Frequency, 3 to 60 Hz.
 - c. Continuous motor horsepower.
 - d. VFD amp output (minimum).
 - e. Continuous current - as shown in Drawings or 115% of rated motor nameplate amps, whichever is higher.
 - f. Short term normal current, 110% of continuous rated current for a minimum duration of 1 minute per every 10 minutes running.
 - g. Short term heavy duty overload current, 150% of continuous rated current for a minimum duration of 1 minute per every 10 minutes running.
 - h. Waveform - sine coded PWM.
 - i. The drive's switching pattern shall be continually adjusted to provide optimum motor flux and avoid the high-pitched audible noise.
 - j. Diodes and transistors shall have a minimum withstand of 1,200 peak inverse voltage (PIV).
6. Environmental The VFD shall be rated to continuously operate under the following environmental conditions:
- a. Ambient temperature, 5°F to 122°F (-15°C to 50°C).
 - b. Altitude, no derating below 3,300 ft.
 - c. Relative humidity, 95% non condensing.
 - d. The drive shall be protected from atmospheric contamination by chemical gasses and solid particles per IEC 60721-3-3, chemical gasses Class 3C2 and solid particles Class 3S2.
 - e. The drive shall be protected from vibration per IEC 60721-3-3 Class 3M4 (sinusoidal displacement 3.0 mm, 2Hz to 9Hz; acceleration 10m/s², 9Hz to 200Hz).
- E. Protection The VFD shall be provided with the following protection:
1. For each programmed warning and fault protection function, the Drive shall display a message in complete English words or Standard English abbreviations. The three (3) most recent fault messages along with time, current, speed, voltage, frequency and DI Status shall be stored in the Drive's fault history. The last ten (10) fault names shall be stored in Drive memory.
 2. The Drive shall include internal MOV's for phase to phase and phase to ground line voltage transient protection.
 3. Output short circuit withstand rating and ground fault protection rated for 100,000 AIC shall be provided per UL508C without relying on line fuses. Motor phase loss protection shall be provided.
 4. The Drive shall provide electronic motor overload protection qualified per UL508C.
 5. Protection shall be provided for AC line or DC bus overvoltage at 130% of max. rated or undervoltage at 65% of min. rated and input phase loss.

6. A power loss ride through feature will allow the Drive to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.
 7. Stall protection shall be programmable to provide a warning or stop the Drive after the motor has operated above a programmed torque level for a programmed time limit.
 8. Underload protection shall be programmable to provide a warning or stop the Drive after the motor has operated below a selected underload curve for a programmed time limit.
 9. Over-temperature protection shall provide a warning if the power module temperature is less than 5°C below the over-temperature trip level.
 10. The VFD shall constantly monitor the load current with an electronic thermal overload relay and trip the drive on motor overload. The electronic overload relay shall be adjustable and compensate for the reduced cooling of the motor at reduced speeds. This protection provides an orderly shutdown should the motor's thermal capabilities be exceeded and eliminates the requirement for conventional motor overload relays.
- F. Digital programmer/controller –The VFD shall be equipped with a front mounted operator control panel (keypad) consisting of a backlit, alphanumeric, graphic display and a keypad with keys for Start/Stop, Local/Remote, Up/Down and Help. Two (2) Softkeys will be provided which change functionality depending upon the position within the parameter hierarchy or state of panel.
1. All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table.
 2. The Display shall have contrast adjustment provisions to optimize viewing at any angle.
 3. The control panel shall provide a real time clock for time stamping events and fault conditions.
 4. The control panel shall include a feature for uploading parameter settings to control panel memory and downloading from the control panel to the same Drive or to another Drive.
 5. All Drives throughout the entire power range shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating.
 6. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus.
 7. The keypad shall be removable and insertable under Drive power, capable of remote mounting, and shall have its own non-volatile memory.
 8. Digital Programmer/Controller (HIM) shall be capable of remote door mounting. Cable for remote digital programmer/controller shall be supplied as shown in the Drawings. The HIM shall be mounted and housed to maintain the NEMA 12 door rating.
 9. The standard operator panel shall provide a start-up, maintenance and diagnostic assistants that guides a new user through initial start-up and commissioning of the Drive as well as provide indications for maintenance and help to diagnose a fault. In addition, a PID assistant, Real-time Clock assistant, Serial Communications assistant, and Drive Optimizer assistant shall be included. A Drive Optimizer assistant permits the user to choose Drive set-up for low noise, drive & motor efficiency or motor control accuracy.
 10. The door mounted human interface module (HIM) display shall be capable to view and adjust the following diagnostic and status indicators:
 - a. VFD Speed % or Frequency

- b. Instantaneous overcurrent.
 - c. Ground fault.
 - d. Overtemperature.
 - e. Overvoltage.
 - f. Undervoltage.
 - g. Overload.
 - h. Overfrequency.
 - i. Amps.
 - j. Voltage.
 - k. Temperature.
 - l. Auxiliary Fault.
 - m. Phase loss.
 - n. Current limit.
 - o. Power and kilowatt hours
 - p. Power up delay.
 - q. Status of discrete inputs and outputs.
 - r. Values of analog input and output signals
 - s. Values of PID controller reference, feedback and error signals.
11. Adjustments The following setting ranges shall be provided and made independently accessible for operator adjustment:
12. Speed/Torque control functions shall include:
- a. Minimum speed/torque limits.
 - b. Maximum speed/torque limits.
 - c. Selection of up to seven (7) preset speed settings or external speed control
 - d. Two (2) independent built-in PID controllers to control a process variable such as pressure, flow or fluid level.
 - e. Two (2) analog inputs shall be programmable to form a reference by addition, subtraction, multiplication, minimum selection or maximum selection.
13. Output control functions shall include:
- a. Current and torque limit adjustments to limit the maximum Drive output current and the maximum torque produced by the motor. These limits shall govern the inner loop torque regulator to provide tight conformance with the limits with minimum overshoot.
 - b. A torque regulated operating mode with adjustable torque ramp up/down and speed/torque limits.
- G. Input and Output Terminations The VFD shall have terminals for input and output cabling as defined in the Conduit and Wire Schedule as shown on the Contract Electrical Drawings.
- 1. Provide power terminal blocks for motor lead connections where drive terminals are hard to reach or require drive cabinet disassembly to connect.
 - 2. Five (5) digital inputs, all independently programmable with at least twenty-five (25) input function selections. Inputs shall be designed for 120 volts AC input or as otherwise shown in the Drawings. Input functions must include time delay start and hand and auto (Ethernet) control.
 - 3. Two (2) form C relay contact digital outputs, all independently programmable with at least thirty (30) output function selections. Relay contacts shall be rated to switch a maximum two (2) Amps rms continuous current at a maximum switching voltage of 30VDC or 250VAC. Function selections shall include indications that the drive is ready (no faults and in remote), running, and are addressable from Ethernet as users choice.

4. Two (2) analog inputs, each selectable for 0VAC - 10VAC or 4mA - 20mA, and independently programmable with at least ten (10) input function selections. Analog input signal processing functions shall include scaling adjustments, adjustable filtering and signal inversion. If the input reference (4-20mA or 0-10V) is lost, the VFD shall give the user the option of the following: (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The Drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus.
 5. Two (2) analog outputs providing 0 (4) to 20mA signals. Outputs shall be independently programmable to provide signals proportional to at least twelve (12) output function selections including output speed, frequency, voltage, current and power.
 6. Provide I/O input and relay output expansion card(s) as needed to accommodate the I/O wiring as shown in the Drawings. The option card shall be integrally mounted to the drive.
- H. Communications – The VFD shall include communications module for interface to the PLC. All settable parameters and instantaneous operational registers shall be accessible from the communications port.
1. Type
 - a. Modbus TCP
- I. Features The VFD shall have the following features:
1. Connection of the three incoming line leads and three-motor leads shall be the only connections necessary for manual operation of the VFD unit. All other wiring shall be prewired at the factory and self contained within the VFD unit. A 120 VAC control power transformer and other auxiliary power supplies shall be provided with the VFD for power to pilot lights, meters, relays, and miscellaneous devices specified to be supplied with the VFD. Lugs shall be provided for connection of all power leads; terminal blocks shall be provided for all other wiring. Relay logic, wiring and enclosure layout shall be equivalent to that shown on the Drawings.
 2. The VFD shall be protected by a circuit breaker disconnect unless otherwise shown in the Drawings. The disconnect shall be externally operated and shall have an operator mechanism that is an integral part of the enclosure. An operator mechanism shall be provided to allow padlocking the disconnect in the "off" position with up to two padlocks.
 3. AC input fuses shall be provided on the line and/or load side of the VFD (if required by the manufacturer) to isolate the VFD power circuitry upon a fault condition.
 4. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.
 5. Transient and surge voltage power line input protection shall be provided for the VFD through use of metal oxide varistors (MOVs), surge protective module, or other approved equal methods. Transient protection integral to the VFD shall be provided to a minimum of 10,000 volts, 50 joules without failure. The transient protection shall meet or exceed ANSI C7, 90 1971 and IEEE 472 1974 Standards without failure. Failure is defined as loss of components in the VFD including power semiconductors and fuses. The VFD shall be protected from the following, as a minimum, power line transients and recover to automatically restart and resume normal operation without posting a fault:
 - a. Switching the primary of a power transformer.

- b. Switching power factor correction capacitors “ON” and “OFF” line.
 - c. De energization or energization of contactors, relays, and other power equipment from the power line.
 - d. Starting and stopping of other motors when powered from Utility.
 - 6. The VFD shall not be affected by or generate excessive electro magnetic interference (EMI). The VFD shall be provided with a radio interference filter (RIF) to meet the following requirements:
 - a. The use of a 4 Watt hand held VHF/UHF transceiver within three feet of the VFD with its doors closed shall not cause erratic operation, loss of configuration, or any other deviation from normal operation.
 - b. The worst case conducted and radiated EMI generated by the VFD shall not be enough to prevent the use of hand held VHF UHF transceivers within three feet of the VFD with its doors closed.
 - 7. Opening of the VFDs input switches, circuit breakers, or output contactors while the VFD is operating under load shall not result in damage to the VFD power or control circuit components.
 - 8. The VFD shall be capable of starting and operating without a motor load connected.
 - 9. Phase loss protection shall be provided to prevent single phasing of the motor load.
 - 10. The VFD shall have an instantaneous electronic trip circuit to protect the VFD from output line-to-line and line-to-ground short circuits. Output line-to-line and line-to-ground short circuits shall not damage the VFD.
 - 11. Automatic fault reset to automatically restart the drive after any type of fault condition. This automatic restart shall repeat up to three attempts. This automatic reset shall be provided to prevent a drive fault from completely locking out on isolated nuisance fluctuations. When the drive is locked out after its automatic reset attempts the operator shall be able to reset the VFD by a local or remote manual reset pushbutton. Fault lockout shall be indicated on the door mounted drive fail pilot light.
 - 12. The VFD shall be capable of continued operation during an intermittent loss of incoming line power up to five cycles.
 - 13. The VFD shall automatically restart upon reapplication of power after a loss of line power. Momentary or sustained power failures shall not fault trip out the VFD or blow any fuses.
 - 14. Any configuration of adjustments or controls not set by a switch or potentiometer shall be stored in nonvolatile memory. No configuration information shall be lost due to power failures of any duration.
 - 15. The VFD shall be capable of starting into a rotating motor without tripping out on a fault.
 - 16. The drive shall have an adjustable voltage boost control capable of providing additional starting torque to the motor at start. This control shall provide the additional voltage only at the frequency range required to start the motor thus reducing the additional motor heating excess voltage would cause at normal operating speeds.
 - 17. The drive shall be equipped with critical frequency jump circuitry which allows the VFD to be setup to skip two bands of frequencies which cause excessive vibration or noise.
- J. Enclosure The enclosure type shall be as shown in the Drawings - freestanding, wall mount, motor control center full section, or MCC cubicle mount construction. All components shall be accessible from the front of the enclosure. Rear or side access shall not be required in order to remove or service any component. The enclosure shall include the following in its construction:

1. The VFD shall incorporate thermostat/run controlled fans for cooling. The air flow through the VFD compartment shall provide proper cooling of the operating VFD at an (external cabinet) ambient temperature of 104°F. Fan mounting shall include reusable air filters on suction. Provide fans for suction and discharge vents as required maintaining air flow and forcing circulation.
2. Provide specific use fans located within the enclosure to cool, directly, specific components such as line filters or DV/DT filters.
3. Thermostat shall have bi-metallic adjustable set point range of 30° to 140°F. Thermostat shall have a switching capacity of 10A at 120 VAC. Provide Hoffman A-TEMNO temperature switch or approved equal to operate fans. Thermostat shall operate fans in parallel with motor running output of VFD.
4. The VFD, including the enclosure and input protection, shall be UL listed for a minimum of 42,000 RMS symmetrical ampere fault withstand capability. VFDs consisting of the VFD, enclosure, and all accessories, that are not UL listed will not be approved.

2.04 SINGLE TURN POTENTIOMETER

- A. Provide manual single turn potentiometer. Potentiometer shall be compatible with the VFD input for manual speed control. Potentiometers shall be Allen-Bradley 800H, Cutler Hammer or equal.

2.05 HARMONIC LINE/LOAD REACTOR

- A. Provide three phase AC reactor intended for use as an input or output filter for AC-PWM variable frequency drives. Line reactor shall be current rated to maximum continuous VFD amp rating or as shown in the Drawings. The impedance of the reactor shall be 5% or as shown otherwise in the Drawings.
- B. The line reactor shall be TCI KLR series, MTE, or equal.

PART 3 EXECUTION

3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].
- B. Requirements of Related Electrical Sections apply to design, documentation construction and assembly of Variable Frequency Drives.
- C. Perform work to remedy non-compliant installations after inspection.

3.02 FIELD ASSISTANCE

- A. Testing, checkout and start-up of the variable frequency drive equipment shall be performed under the technical direction of a factory trained authorized manufacturer representative.
 1. The setup and programming of the VFD shall be provided by a factory-trained representative who is authorized by the VFD manufacturer to perform the startup. This setup and programming shall be done prior to and during the first application of power to the motor. The VFD electronic motor overload protection shall be set to meet the motor nameplate and NEC Code requirements.

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- 2. Provide testing as specified in Electrical Specifications [Factory and Field Testing].
 - B. Provide 4 hour (not including travel time) of “VFD Setup” Training on operating and maintenance procedures.
- 3.03 WARRANTY
- A. Provide warranty as specified in Electrical Specifications [Electrical General; Warranty].

END OF SECTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section defines factory and field testing requirements of electrical and instrumentation equipment and as specified in this section and in Electrical Specifications. All equipment provided under Electrical Specifications and electrical equipment provided under other sections shall be tested as specified herein.
- B. The Electrical Contractor shall coordinate at no additional cost to the Owner, the services of an approved qualified third party independent testing company for the purpose of performing specific tests as outlined in EXECUTION, Field Test of this section.
- C. The System Integrator, Testing Company and/or Electrical Contractor shall provide all labor, tools, material, power, and technical supervision to perform the specified tests and inspections.
- D. The Electrical Contractor shall be present during field testing and assist the System Integrator and/or Testing Company in testing all equipment. The Electrical Contractor shall be ready to correct any wiring problems found during testing.
- E. The Application Programmer (defined in Electrical Specifications [Electrical General].) and/or Construction Manager will be actively engaged in Operational Testing and Commissioning. These efforts shall be combined efforts of the Application-Programmer/Construction-Manager/Engineer and Contractor. The Contractor shall facilitate test as outlined herein such that hardware, software and application programming are tested completely and all applicable test documentation is completed.
 - 1. Expect that field operational testing (SCADA and PLC automated controls checkout) is going to require 2 weeks after pre-operational tests are done. Contractor and System Integrator shall assist in this start-up. Coordinate with Owner Representative to schedule this start-up period.
- F. It is the intent of these tests to ensure that all equipment is operational within industry and manufacturer's tolerances and is assembled in accordance with design plans and Specifications.
- G. The Owner and/or Construction Manager may witness testing in effort to insure quality and verify results. The Contractor is required to provide notification 2 weeks prior to any test that are intended to be documented and submitted for approval or are final tests. The Owner and Construction Manager must specifically decline witness of each test to be performed, and the test must be successful, and it must be documented on the day of test, in order for it to not have to be repeated in the presence of an authorized witness. Only the Owner or Construction Manager may assign an authorized witness.
- H. All tests shall be documented in writing by the person performing the test on the test forms submitted (and similar to those shown at the end of this section) and signed by the Engineer as satisfactorily completed. The Testing Company, Electrical Contractor or System Integrator performing tests shall keep a detailed log of all tests that failed or did not meet Specifications, including date of occurrence and correction.

- I. The Contractor shall perform all applicable testing of Owner supplied or existing equipment as a unit and as part of a system. Testing shall include documentation and witness sign-off.
- J. The radio and communications equipment shall be completely configured by the Contractor for permanent operation. Radio diagnostics, addresses, and configuration shall be recorded and provided with testing submittals. Provide data in tabular format on Excel spreadsheet. Contractor is required to test every path, link, repeater until optimum results are obtained. Test form example is not provided for this purpose and must be generated by the Contractor.

1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Project Drawings
- C. Additional testing may be specified in other Electrical Specifications.

1.03 FACTORY AND FIELD GENERAL REQUIREMENTS

- A. Testing General
 - 1. Prior to any field testing Operation & Maintenance Manuals shall have been submitted and approved.
 - 2. The test forms shall be completed by the contractor during testing and calibration of all equipment. All tests shall be witnessed by the Owner's Representative. Completed test forms shall be given to the Owner's Representative the day of the test. Complete two sets of test forms if Contractor wants to keep a copy.
 - 3. The Contractor shall give the Engineer 10 working days notice of the dates and time for inspections and testing.
 - 4. Include test results in the Maintenance and Operational Manual.
 - 5. As a minimum, all the tests indicated/specified on the test forms shall be performed and test forms filled out by the Contractor.
 - 6. Prepare and submit formal test procedures and forms at least two weeks prior to the start of testing. Testing shall not commence until the test procedures have been reviewed and approved. Submit a combined test procedure submittal with separate sections for factory and field tests.
 - 7. If the results of any of tests are unacceptable, the Contractor shall make corrections and perform the tests again until they are acceptable; these tests shall be done at no additional cost to owner.
- B. Failure to Meet Test
 - 1. Any system, material or workmanship which is found defective on the basis of these tests shall be reported immediately following the test. The Contractor shall replace the defective material or equipment and have tests repeated.
- C. Safety
 - 1. Testing shall conform to the respective manufacturer's recommendations. All manufacturers' safety precautions shall be followed.
 - 2. Safety, as shown herein and in other divisions, shall be a combination of all methods and practices described. Safety practices may not be determined based on the least restrictive requirement, but instead, on the most restrictive requirement. Obtain clarification if there is any question prior to performing tests.

3. The procedures stated herein are guidelines for the intended tests, the Contractor shall be responsible to modify these tests to fit the particular application and ensure personnel safety. Absolutely no tests shall be performed in such a fashion that personnel safety is jeopardized.
4. The Contractor shall have two or more personnel present at all tests.
5. Two non-licensed portable radios shall be provided by the Contractor for use during testing.
6. Contractor shall comply with California Electrical Safety Orders (ESO) and Occupational Safety and Health Act (OSHA): All test and procedures shall comply with ESO and OSHA as to safety, protective clothing, clearances, padlocks and barriers around electrical equipment energized during testing.
7. The first set of tests to be performed (pre-energization) shall determine the suitability for energization and shall be completed with all power turned off.

1.04 QUALIFICATIONS

- A. Testing Company
 1. Testing company shall have been actively engaged in the type of electrical testing specified in this Division for the past three years (minimum). The Testing Company representative shall have two years experience in field testing of equipment working for the Testing Company or equivalent. The following Electrical Testing Companies are pre-approved.
 - a. EETS (916) 339-9691
 - b. Industrial Test (888)-809-8550
 - c. Emerson Electrical Reliability Services
 - d. Apparatus Testing and Engineering (916) 853-6280
 - e. Apparatus Testing and Engineering (925) 454-1363
 - f. Power Systems Testing (925) 583-2361
 2. Testing Companies not listed are required to submit company and individual representative resumes for review and approval.
- B. System Integrator Representative
 1. The system integrator representative shall have 1 year experience in field testing of equipment working for the System Integrator or equivalent. If the representative does not demonstrate necessary experience or competence during testing or start-up, the System Integrator shall provide a representative meeting the required competence and experience.
- C. Electrical Contractor Representative
 1. The Electrician shall have 5 years minimum experience working with industrial control systems and have a Journeyman level experience rating.

1.05 SUBMITTAL REQUIREMENTS

- A. The Contractor shall ensure that the Testing Company, System Integrator, and all equipment suppliers provide the submittal documentation required in this section. Submittals shall be complete, neat, orderly, and indexed. The Contractor shall check all submittals required under this Division for the correct number of copies, adequate identification, correctness, and compliance with the Contract Specifications and Drawings, and initial all copies certifying compliance.
- B. The System Integrator shall assemble and submit for approval complete testing procedures and forms at least two weeks prior to the start of testing. Contractor is

responsible for compiling testing procedures and forms from multiple sub-contractors as required.

- C. Test submittal shall include: (as applicable)
 - 1. Proposed procedure for operational testing whether it is performed in the factory or field. Procedure shall include method, simulated I/O requirements, bypass piping, telemetry, and necessary materials and equipment to conduct test.
 - 2. Test forms (for all tests, factory and field, and regardless of who performs tests). Test forms shall be electronically completed prior to submittal with entry spaces filled to the extent possible. The only remaining data that shall require completion during the test is the test data itself. Test forms shall be provided as illustrated at the end of this section or equal.
 - 3. Approved shop one-line, elementary diagrams and PLC I/O drawings.
 - 4. Control strategies photocopied at 75% reduction with room at the side of page for comments on each paragraph or control strategy.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. Test equipment required to perform testing and document results shall be provided by Contractor, Testing Company or System Integrator.
- B. Test instruments shall be calibrated to references traceable to the National Institute of Standards and Technology. Instrument calibration shall be current to one year from date of start-up. Test equipment accuracy shall be at least twice the accuracy of instrument being calibrated. Test instrument certificates of calibration shall be on-hand and provided prior to testing.

All test equipment to be used as part of the testing shall be listed in the submitted testing sheets. Contractor supplying the component or system to be tested shall provide all necessary test equipment.

- C. The overall accuracy of each input and output loop shall be checked to ensure that it is within manufacturer's Specification tolerances. In no case shall the error exceed 0.25% or 0.04 mA.

PART 3 EXECUTION

3.01 FACTORY TESTING

- A. General Requirements
 - 1. The System Integrator shall conduct a thorough and complete factory test witnessed by Engineer per the criteria specified herein. Factory test shall be held within 150 miles of project location.
 - 2. Temporary wiring and equipment shall be provided and connected during these tests to simulate the complete assembled system.
 - 3. The testing shall not be started until the manufacturer has completed fabrication, wiring, setup, programming; quality control testing; and can demonstrate the system is complete and operational.

4. The equipment required for factory testing shall consist of, but is not limited to, control panels, MCCs, and/or miscellaneous electrical panels as provided under this contract.
5. Two digital multimeters/signal generators (minimum +/- 0.1% accuracy) with clip on leads shall be supplied and utilized during testing for measurement of digital and analog outputs.
6. All factory tests shall be conducted at the System Integrator's facility. All factory tests shall be completed prior to shipment to the jobsite. The equipment shall be fully assembled, and connected (and programmed) similar to as it will be installed.
7. The length of the factory testing shall be a minimum of one (1) working day(s) (8 hours per day).
8. If the equipment is not ready for factory testing, the test will be cancelled and rescheduled for a later date. The Contractor shall be responsible for paying liquidated damages for expenses incurred by the Owner Representative to come to a cancelled test. One thousand dollars (\$1000.00) in liquidated damages shall be deducted from his contract each occurrence.
9. Faulty and/or incorrect hardware or software operation of major portions of the system may, at the discretion of the Engineer, be cause for suspension, cancellation, or restarting of the factory test, at no additional cost to the Owner or extension in Contract time.
10. The Systems Integrator shall develop, furnish, and install a test program to be loaded into PLCs to verify all Logic Controller I/O Point to Point Tests prior to start of applications program testing. Systems Integrator shall use a computer running PLC programming software to confirm I/O calibration and status, force outputs and communications configuration.
11. The factory test will be considered complete only when the integrated system has successfully passed all tests. No electrical equipment shall be shipped to jobsite without completed test documentation.
12. During the testing period, under the supervision of the System Integrator, the Owner's Representative shall have unlimited and unrestricted access to the usage and testing of system hardware, configuration, software, meters and tools.
13. The System Integrator shall pay all expenses incurred by his personnel including labor, material, transportation, lodging, daily subsistence, and other associated incidental costs during the factory testing.
14. Acceptance and witnessing of the factory tests does not relieve or exclude the Contractor from conforming to the requirements of the Contract Documents.
15. All modifications to documentation as a result of the factory tests shall be corrected and completed before the submittal and delivery of "Operation and Maintenance" Manuals.
16. Copies of the completed and witnessed factory testing forms shall be included in the Operation and Maintenance Manual.

B. Factory Tests

1. Structured Factory Tests: The associated factory tests are to be performed by the System Integrator and witnessed by the Owner's Representative. The associated test forms shall be completed during each stage of the test.
 - a. Visual and Mechanical Inspection Tests
 - b. Wiring Tests
 - 1) Contractor shall confirm correct panel wiring per System Integrator panel shop drawings. Panel shop drawings shall be compared with Contract P&IDs and other Drawings to verify all hardwire logic are accounted for. Panel drawings used in factory

tests shall be redlined and inserted into Factory Testing Results submittal.

- c. MCC and Control Panel Pre-Operational Tests
- d. Logic Controller I/O Point to Point Tests
- 2. Unstructured Factory Tests: The various unstructured tests shall include, but are not limited to, the following.
 - a. Simulate the equipment failure and power fail/restart of PLC. Check the effects of each failure on maintaining operations with the remaining equipment.
 - b. The factory tests, as a minimum, shall simulate all normal and abnormal operating conditions including steady state, change of state, variable changes, fluctuations, transients, upsets, start up, shutdown, power failure, and equipment failure conditions.
 - c. Measure and test all power supplies for correct voltage. Operate rechargeable devices under battery power to test run duration, alarms and automatic recovery.

3.02 FIELD TESTING

- A. General Requirements
 - 1. Field testing is broken down into 4 components
 - a. Pre-Energization testing
 - b. Pre-Operational Testing
 - c. Operational Testing
 - d. Trial Period/Commissioning
 - 2. Project wide, all Pre-Energization testing must be completed prior to Pre-Operational testing, all Pre-Operational testing must be completed prior to Operational Testing, and all Operational Testing must be completed prior to Commissioning.
 - a. Any deviation of this order, whether on a component level or larger scale, must be approved.
 - b. Out of order testing, if allowed, will be evaluated on a case-by-case basis when brought to the attention of the Owner's Representative. The Owner's Representative may require that the entire system, or portions thereof, be retested once the missing component(s) are installed and functional.
 - 3. All equipment supplied by the Contractor or others shall be tested by Contractor per these specifications.
 - 4. Two digital multimeters/signal generators (minimum +/- 0.1% accuracy) , AC current meters, torque wrench, and other specialized test equipment shall be provided by the Contractor for use during testing.
 - 5. If the equipment is determined not to be ready for testing, the test will be cancelled and rescheduled for a later date.
 - 6. Faulty and/or incorrect hardware or software operation of major portions of the system may be cause for suspension, cancellation, or restarting of the area of testing, at no additional cost or extension in Contract time.
 - 7. During the Operational testing period, under the supervision of the System Integrator, the Owner's Representative shall have unlimited and unrestricted access to the usage and testing of all hardware and software in the system.
 - 8. The System Integrator shall pay all expenses incurred by his personnel including labor, material, transportation, lodging, daily subsistence, and other associated incidental costs during field testing.
 - 9. Acceptance and witnessing of the tests does not relieve or exclude the Contractor from conforming to the requirements of the Contract Documents.

10. All modifications to documentation as a result of the tests shall be corrected and completed before the delivery of "as-built" documentation.
11. Copies of the completed and witnessed field testing forms shall be included in the Operation and Maintenance Manual.
12. The various contractors on this project (General Contractor, Electrical Contractor, Testing Company, and System Integrator) shall assume the lead role in testing activities as listed below. The Contractor shall obtain assistance of suppliers and/or manufacturers representatives for any major equipment testing.
 - a. Electrical Contractor:
 - 1) Pre Energization Tests
 - a) Visual Mechanical Tests
 - b) Wire Insulation and Continuity Tests.
 - c) Panelboard Tests
 - d) Breaker Tests
 - 2) Operational Tests.
 - a) Generator Tests
 - 3) Trial Period
 - 4) Commissioning.
 - b. System Integrator:
 - 1) Pre-Operational Tests
 - a) Visual Mechanical Tests
 - b) Control panel pre-operational test
 - c) MCC pre-operational test
 - d) Motor Tests.
 - e) PLC I/O point to point tests.
 - f) Instrumentation switch tests
 - g) Instrumentation transmitter tests.
 - 2) Operational Tests.
 - 3) Trial Period
 - 4) Commissioning
 - c. Testing Company
 - 1) Grounding System Tests
 - 2) Breaker Device Tests
 - d. General Contractor
 - 1) Test Scheduling
 - 2) Operational Tests.
 - 3) Trial Period
 - 4) Commissioning.
 - e. Application Programmer (software systems)
 - 1) Operational Tests.
 - 2) Trial Period
 - 3) Commissioning.

B. Electrical Field Tests – The following test shall be performed within each test category. Complete test forms for each electrical panel, instrument, and/or device. Provide separate form for each component to be tested.

1. Pre-Energization Inspections and Tests:
 - a. Visual and Mechanical Inspection Tests
 - b. Wire Insulation and Continuity Tests
 - c. Grounding System Tests
 - d. Panelboard Tests
 - e. Breaker Tests
2. Pre-Operational Tests:
 - a. MCC Pre-operational Tests:

- b. Control Panel Pre-operational Tests:
 - c. Motor Testing:
 - d. Generator Testing (if generator is furnished)
 - e. Harmonic Measurement
 - f. Instrumentation Switch Calibration Tests
 - g. Instrument Transmitter Calibration Tests
 - h. PLC I/O point tests.
 - i. Communication Tests
 - 1) The Contractor shall verify that all communications via radio, telephone, wireline, fiber optic, or other are functional and ready for operational testing. Revise all configurable parameters without additional cost to the Owner as required for an optimally functional system.
 - 2) Verify that all components of the communication system operate together under all operating and power restart conditions. If faults occur, investigate source of problem and correct. Revise all configurable parameters without additional cost to the Owner.
 - 3) Change setpoints from SCADA and confirm that corresponding field setpoint changes correctly. Check every I/O point on every screen, trend, and database.
3. Operational Tests:
- a. After all the previous tests in this subsection are complete, the test forms are completed and signed-off, the Contractor shall conduct operational testing.
 - b. Representatives from the General Contractor, Electrical Contractor, System Integrator, and Owner's Representative shall be present during testing. Operational testing shall be performed by Contractor in the presence of the Owner's Representative.
 - c. During operational testing the Contractor shall follow the instructions of the Owner. The Owner may place restrictions on operation that must be followed by the Contractor during testing. Any accidents or fines caused by actions of the Contractor where warnings or restrictions were placed, shall be remedied or paid by the Contractor.
 - d. Alarm Tests
 - 1) Generate the digital and/or analog signals at the primary device to verify that each PLC I/O point is functional and properly programmed. Verify that all parameters (i.e., setpoints, enable/disable toggle bits, timers, etc.) for the alarms operate according to the Specifications. Multiple alarm states (i.e., LO, LO LO, HI, HI HI, etc.) shall be checked.
 - e. Operational Control Tests
 - 1) Generate the digital and/or analog signals at the primary device by raising or lowering the actual measured process. Inject signal into the terminals or utilize a "force" function within the device only as necessary. Verify that each control system is functional and properly configured and programmed.
 - 2) Each line of control logic in the Control Strategies section shall be checked. When the complete control strategy has been checked, it shall be signed and dated by testing person and person witnessing test.
 - 3) Verify that all parameters (i.e., setpoints, runtimers, totalization, etc.) operate according to the Specifications.

- 4) Verify that all data, setpoints, alarms are being received at SCADA correctly and that all I/O points on screen are true and accurate representations of field information.
- f. Other Tests
 - 1) Force a power failure and power fail/restart of PLC and all other systems. Check the effects of each failure on each piece of equipment and automatic recovery.
 - 2) Force a PLC communication error. Demonstrate error detection, alarming, and recovery.
 - 3) Perform additional operational testing that has not already been witnessed.
 - 4) Perform any additional operational testing as necessary to confirm robust and error free operation under all operational conditions.
- 4. Trial Period
 - a. Station/Equipment shall be activated to automatically run for 5 days, 24 hours per day Monday through Friday.
 - b. During the trial period the Owner's Representative will test all modes of operation and will look for errors and malfunctions. A punchlist will be generated to be completed by Contractor and re-tested prior to Commissioning.
 - c. If equipment failure occurs during the trial period, the Contractor shall repair or replace the defective equipment and shall begin another trial period, Monday through Friday.
 - d. This test shall be repeated until all new equipment functions acceptably and without failure for consecutive days.
- C. Commissioning:
 - 1. Commissioning shall not commence until Operational testing and System Training are complete with documentation submitted and with prior approval.
 - 2. Commissioning period
 - a. The new equipment shall be activated by the Contractor to operate in full automatic for 10 consecutive days, 24 hours per day. Commissioning shall only start on Mondays or Tuesdays.
 - b. During Commissioning, the Owner will monitor and run the station in normal automatic mode. If equipment failure occurs during Commissioning, the Contractor shall repair or replace the defective equipment and shall begin another commissioning period after repairs are complete.
 - c. Parallel, existing and/or back-up systems shall remain in place and functional during commissioning period. Demolition of parallel, existing or back-up systems shall not begin until commissioning is completed.
 - d. This test shall be repeated until the new equipment functions acceptably for a consecutive commissioning period.
 - e. Warranty will begin at the start of a successful commissioning period. However, if major hardware failure occurs during commissioning, the warranty and commissioning will restart once the problem has been identified and repaired.

3.03 WARRANTY:

- A. Provide warranty per Electrical Specifications [Electrical General, Warranty].
 - 1. The completion of the above tests does not relieve the Contractor from any warranties specified in the Electrical Specifications or other sections.

2. Warranty shall begin on the start date of a successful Commissioning period.

3.04 FINAL ACCEPTANCE:

A. Final Acceptance per Electrical Specifications [Electrical General].

TEST FORMS

Index of Forms:

PC	Power Conductor Test Form
CC	Control Conductor Test Form
IC	Instrumentation Conductor Test Form
GS	Grounding System Test Form
VM	Electrical Equipment Visual and Mechanical Inspection Form
PB	Panelboard Test Form
CPO	Control Panel Operational Test Form
BD	Breaker Device Test Form
GCL	Generator Field Check List
GPT	Generator Performance Test Form
GSLD	Generator Sound Level Data Form
MOTOR	Motor Test Form
HM	Harmonic Measurement Test Form
IOP	Programmable Logic Controller I/O Point-to-Point Test Form
ISC	Instrumentation Switch Calibration Test Form
ITC	Instrumentation Transmitter Calibration Test Form

END OF SECTION

POWER CONDUCTOR TEST FORM

PROJECT NAME: _____
TESTING COMPANY: _____
EQUIPMENT #: _____

DATE OF TEST: _____
TEST LOCATION: _____

INSULATION TESTS						
CONDUIT	PHASE TO GROUND			PHASE TO PHASE		
#	A	B	C	AB	BC	CA

NOTES:

- 1) Use single form for up to 25 power conduits. Use additional forms as necessary.
- 2) Disconnect both ends of wiring prior to megger tests.
- 3) Megger insulation resistances of all 600 volt insulated conductors using a 500 volt megger for 10 seconds minimum (30 seconds minimum for motor leads). Make tests with circuits installed in conduit and isolated from source and load. Each conductor shall be meggered conductor-to-conductor and conductor-to-ground. These tests shall be made on cable after installation with all splices made up and terminations installed but not connected to the equipment.
- 4) Each megger reading shall not be less than 22 Meg-ohms resistive. Corrective action shall be taken if values are recorded less than 10 Meg-ohms. Conductors with low ohm values, that do not match similar lengths of conductors the same size, shall be replaced at no additional cost to the Owner.
- 5) Values of different phases of conductors in the same conduit run showing substantially different Meg-ohm values, even if showing above 22 Meg-ohms shall be replaced.

CERTIFIED BY: _____
SIGNATURE COMPANY DATE

WITNESSED BY: _____
SIGNATURE COMPANY DATE

CONTROL CONDUCTOR TEST FORM

PROJECT NAME: _____
 TESTING COMPANY: _____

DATE OF TEST: _____
 TEST LOCATION: _____

INSULATION TESTS											
COND. # OF #	COND. TO GROUND	CONDUCTOR TO CONDUCTOR									
		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
1		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X									
2		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X								
3		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X							
4		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X						
5		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X					
6		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X				
7		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X	X			
8		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X	X	X		
9		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X	X	X	X	
10		1 TO #	2 TO #	3 TO #	4 TO #	5 TO #	6 TO #	7 TO #	8 TO #	9 TO #	10 TO #
		X	X	X	X	X	X	X	X	X	X

NOTES:

- 1) Use single form for each conduit.
- 2) Disconnect both ends of wiring prior to megger tests.
- 3) Megger insulation resistances of all 600 volt insulated conductors using a 500 volt megger for 10 seconds. Make tests with circuits installed in conduit and isolated from source and load. Each conductor shall be meggered conductor-to-conductor and conductor-to-ground. These tests shall be made on cable after installation with all splices made up and terminations installed but not connected to the equipment.
- 4) Each megger reading shall not be less than 22 Meg-ohms resistive. Corrective action shall be taken if values are recorded less than 10 Meg-ohms. Conductors with low ohm values, that do not match similar lengths of conductors the same size, shall be replaced at no additional cost to the Owner.
- 5) Values of different phases of conductors in the same conduit run showing substantially different Meg-ohm values, even if showing above 22 Meg-ohms shall be replaced.

CERTIFIED BY: _____
 SIGNATURE

 COMPANY

 DATE

WITNESSED BY: _____
 SIGNATURE

 COMPANY

 DATE

INSTRUMENTATION CONDUCTOR TEST FORM

PROJECT NAME: _____
TESTING COMPANY: _____
CONDUIT NUMBER: _____

DATE OF TEST: _____
TEST LOCATION: _____
EQUIPMENT #: _____

CONTINUITY TESTS			INSULATION TESTS	
CONDUCTOR PAIR # OF #	CONDUCTOR TO CONDUCTOR	CONDUCTOR TO SHIELD	CONDUCTOR TO CONDUCTOR	SHIELD TO GROUND

- NOTES:
- 1) Disconnect both ends of wiring prior to megger tests.
 - 2) Megger insulation resistances of all 600 volt insulated conductors using a 500 volt megger for ten seconds. Make tests with circuits installed in conduit and isolated from source and load. Each conductor shall be meggered conductor-to-conductor and conductor-to-ground. These tests shall be made on cable after installation with all splices made up and terminators installed but not connected to the equipment.
 - 3) Each megger reading shall not be less than 10 Meg-ohms resistive. Corrective action shall be taken if values are recorded less than 10 Meg-ohms. Conductors with low ohm values, that do not match similar lengths of conductors the same size, shall be replaced at no additional cost to the Owner.
 - 4) Continuity Tests: Each instrumentation conductor twisted shielded pair shall have the conductor and shield continuity measured with an ohmmeter. Conductors with high ohm values, that do not match similar lengths of conductors the same size, shall be replaced at no additional cost to the Owner.

CERTIFIED BY: _____
SIGNATURE COMPANY DATE

WITNESSED BY: _____
SIGNATURE COMPANY DATE

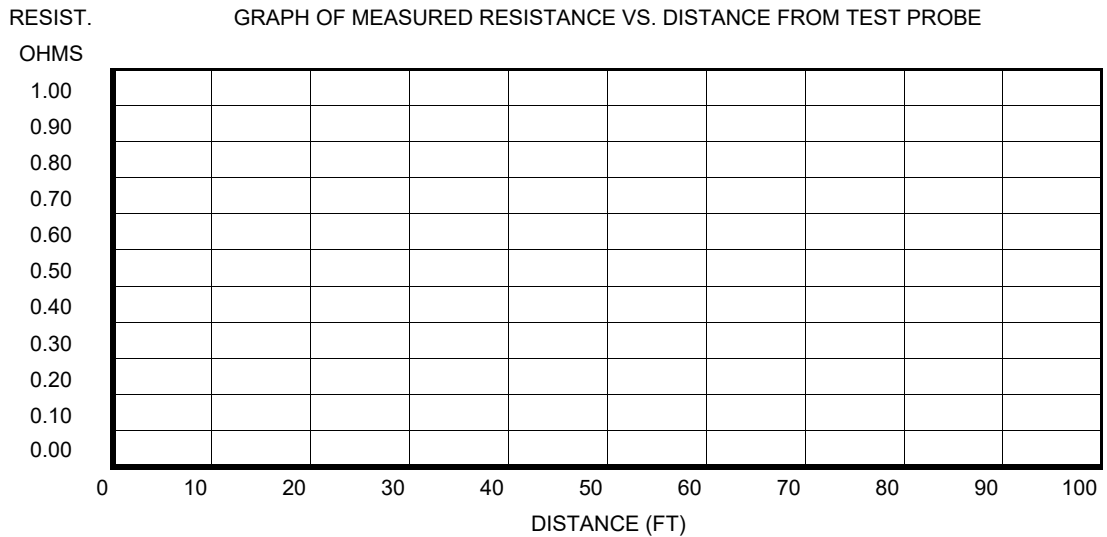
GROUNDING SYSTEM TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____
 TESTING COMPANY: _____ TEST LOCATION: _____
 TECHNICIAN: _____ TEST LOCATION: _____
 EQUIPMENT NAME: _____
 SOIL CONDITION: circle one WET DRY MOIST DAYS SINCE LAST RAIN # _____ OVER 7 _____
 TEST ROD LOCATION RELATIVE TO SYSTEM GROUND UNDER TEST (DISTANCE AND DIRECTION) _____
 COMMENTS:

FALL OF POTENTIAL TEST

GRAPH OF MEASURED RESISTANCE VS. DISTANCE FROM TEST PROBE

MEASURED VOLTAGE PROBE	
DIST.	RESIST.
20	
30	
40	
50	
60	
70	
80	
90	



NOTES:

- 1) Use ground resistance test meter and perform separate ground test for each building or independently derived grounding system.
- 2) Verify ground system is in compliance with drawings and specifications.
- 3) Perform the test not less than two days after the most recent rainfall and in the afternoon after any ground condensation (dew) has evaporated.
- 4) Investigate point-to-point resistance values which exceed 1.0 ohm. Correct (by adding additional grounding systems as necessary) and re-test. Consult design engineer if for direction on additional grounding materials and methods.
- 5) Connect all ground electrodes and/or UFER ground together and perform fall of potential test.
- 6) Perform fall-of-potential test in accordance with IEEE Standard 81 and NETA 7.13 on the main grounding electrode or system. Install reference electrode(s) a minimum of 100 feet from system under test. Connect power supply. Install/test/record/remove the potential test electrode every 10 feet during test.
- 7) Test measurements shall be made at 10 feet intervals in a straight line beginning at 90 feet and ending 10 feet from the system being tested. Plot resistance readings on graphical chart above.
- 8) Perform point-to-point resistance tests to verify low resistance between the main grounding system and all electrical equipment connected to the grounding system. Document results graphically from rod to rod and rod to equipment. Purpose is to check Cad-Weld connections and continuity point to point.

CERTIFIED BY: _____
SIGNATURE
COMPANY
DATE

WITNESSED BY: _____
SIGNATURE
COMPANY
DATE

ELECTRICAL EQUIPMENT VISUAL AND MECHANICAL INSPECTION FORM

PROJECT NAME: _____
 TESTING COMPANY: _____
 EQUIPMENT NAME: _____

DATE OF TEST: _____
 TEST LOCATION: _____
 EQUIPMENT #: _____

NAMEPLATE DATA (complete as applicable)

MANUFACTURER: _____
 MODEL #: _____
 VOLTAGE: _____
 BUS AMPERAGE: _____
 BUS TYPE: _____
 VERTICAL BUS: _____
 GROUND BUS: _____

ENCLOSURE: _____
 U.L. #: _____
 PHASE: _____
 SERVICE: _____
 BUS BRACING: _____
 HORIZONTAL BUS: _____
 NEUTRAL BUS: _____
 SERIES #: _____

PHYSICAL INSPECTION CHECKLIST

ENTER A-ACCEPTABLE R-NEEDS REPAIR OR REPLACEMENT NA-NOT APPLICABLE

ITEM	CHECK	NOTES
CHECK NON-ELECTRICAL FASTENERS FOR TIGHTNESS		
TORQUE TEST ALL WIRING AND BUS CONNECTIONS		
VERIFY ANCHORAGE IS PER SPECS AND/OR CALCS		
CHECK BUS BRACING AND CLEARANCE		
CHECK MAIN GROUNDING CONNECTION AND SIZE		
VERIFY GROUND BUS BONDING		
VERIFY EQUIPMENT GROUNDS		
VERIFY CONDUIT GROUNDS AND BUSHINGS		
CHECK NEUTRAL BUS AND CONNECTIONS		
VERIFY ALL BREAKERS AND FUSES ARE RATED PROPERLY		
INSPECT FOR BROKEN OR DAMAGED EQUIPMENT		
INSPECT ALIGNMENT OF PANEL AND DOOR		
VERIFY REMOVAL OF ALL DEBRIS AND DUST		
VERIFY WIRE LABELS ARE INSTALLED		
VERIFY ALL WIRE TERMINATIONS		
CHECK FOR PROPER WIRE SIZES		
CHECK FOR PROPER WIRE COLOR CODES		
VERIFY ALL NAMEPLATES		
CHECK FOR PROPER CLEARANCES AND WORKING SPACE		
INSPECT ALL PAINT SURFACES		
CHECK HEATERS AND THERMOSTATS		
CHECK VENTILATION AND FILTERS		
CHECK IF DRAWINGS MATCH EQUIPMENT		
CHECK ACCURACY OF OPERATION & MAINTENANCE		

NOTES:

- 1) Complete checklist above. Note any items that were found out of compliance.
- 2) Torque all electrical connections to values defined by equipment manufacturer or per NEC 110-14.

CERTIFIED BY: _____
SIGNATURE

COMPANY

DATE

WITNESSED BY: _____
SIGNATURE

COMPANY

DATE

PANEL BOARD TEST FORM

PROJECT NAME: _____
 TESTING COMPANY: _____
 PANEL NAME: _____

DATE OF TEST: _____
 TEST LOCATION: _____
 PANEL TAG #: _____

PANELBOARD NAMEPLATE DATA

UL #: _____
 MAIN BREAKER RATING: _____
 PHASE: _____
 VERTICAL BUS RATING: _____
 NEUTRAL BUS RATING: _____
 GROUND BUS RATING: _____
 ENTRY LOCATION: _____

MANUFACTURE: _____
 MODEL #: _____
 VOLTAGE: _____
 BUS AMPERAGE: _____
 BUS TYPE: _____
 ENCLOSURE: _____
 SERIES: _____

PHYSICAL INSPECTION CHECKLIST

ITEM	CHECK	NOTES
TIGHTEN ALL BOLTS AND SCREWS		
TIGHTEN ALL WIRING AND BUS CONNECTIONS		
VERIFY ALL BREAKERS AND FUSES ARE RATED PROPERLY		
CHECK BUS BRACING AND CLEARANCE		
CHECK MAIN GROUNDING CONNECTION AND SIZE		
VERIFY GROUND BUS BONDING		
VERIFY EQUIPMENT GROUNDS		
VERIFY CONDUIT GROUNDS AND BUSHINGS		
CHECK NEUTRAL BUS AND CONNECTIONS		
INSPECT FOR BROKEN OR DAMAGED EQUIPMENT		
INSPECT ALIGNMENT OF PANEL AND DOOR		
VERIFY ANCHORAGE		
VERIFY REMOVAL OF ALL DEBRIS AND DUST		
VERIFY CIRCUIT BREAKER LEGEND PER CONTRACT		
INSPECT ALL PAINT SURFACES		
VERIFY WIRE LABELS ARE INSTALLED		
VERIFY ALL WIRE TERMINATIONS		
VERIFY PANEL SCHEDULE WITH TERMINATIONS		
VERIFY PROPER WIRE SIZE		

NOTES:

1) Complete checklist above by entering a checkmark for acceptable, R for needs repair or attention

CERTIFIED BY: _____
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COMPANY

DATE

CONTROL PANEL PRE-OPERATIONAL TEST FORM

PROJECT NAME: _____
 TESTING COMPANY: _____
 CONTROL PANEL NAME: _____
 CONTROL PANEL MANUFACTURER: _____

DATE OF TEST: _____
 TEST LOCATION: _____
 CONTROL PANEL TAG #: _____
 CONTROL PANEL TYPE: _____

CATEGORY	EQUIPMENT TAG #	DEVICE CHECKS AND TEST								
		CONTROL SWITCHES	OPERATOR INTERFACE	PANEL METERS	PANEL LIGHTS	PANEL NAMEPLATES	PLC POWER SUPPLY	I/O CARDS		
Height										
Voltage										
Function										
CATEGORY	EQUIPMENT TAG #	POWER SUPPLY 1 (V)	POWER SUPPLY 2 (V)	POWER SUPPLY 3 (V)	UPS	PANEL LIGHTS				
Function										
Voltage										

NOTES:

- 1) Set configurable parameters and verify voltage input prior to applying power.
 - 2) Verify equipment powers up and operates correctly.
 - 3) Perform trip functions and verify equipment returns to normal operation with only necessary operator intervention.
 - 4) Complete checklist above by entering a checkmark (CM) for acceptable, or R for needs repair or attention, or NA for not applicable
- Attention Required:

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BREAKER DEVICE TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____
 TESTING COMPANY: _____ TEST LOCATION: _____
 PANEL NAME: _____ PANEL TAG #: _____
 PANEL TYPE: _____

EQUIPMENT INFORMATION

EQUIPMENT NAME: _____ EQUIPMENT H.P.: _____
 EQUIPMENT TAG#: _____ EQUIPMENT KVA: _____

BREAKER INFORMATION

MANUFACTURE: _____ VOLTAGE: _____ CHARACTER: _____
 PART #: _____ INTERRUPT: _____ CURVE: _____
 FRAME #: _____ RATING: _____ LOCATION: _____

BREAKER TESTS

MFGR TRIP TIME @300% MIN: _____ BREAKER RATING/ RANGE: _____
 MFGR TRIP TIME @300% MAX: _____ FINAL BREAKER SETTING: _____
 MFGR INST. PICKUP AMPS: _____

CONTACT RESISTANCE TESTS - OHMS

INSULATION RESISTANCE TESTS - MEGOHMS

PHASE A	PHASE B	PHASE C	A-GND	B-GND	C-GND

CURRENT TESTS

INSTANTANEOUS CURRENT TRIP TESTS

TRIP TIME IN SECONDS @ 300% AMPS

AMPS

PHASE A	PHASE B	PHASE C	PHASE A	PHASE B	PHASE C

ADDITIONAL TESTS AND SETTING AS APPLICABLE

FUNCTION	PICK UP		DELAY-TIME		
	RANGE	SETTING	RANGE	SETTING	
LONG TIME					
SHORT TIME					
GROUND FLT.					

NOTES:

- 1) All breakers shall be checked for proper mounting, conductor size, and feeder designation. Operate circuit breaker to ensure smooth operation. Inspect case for cracks or other defects. Check tightness of connection with torque wrench in accordance with manufacturer's recommendations.
- 2) Thermal magnetic breakers, 100 amps and above, shall be test per NETA specification 7.6.1.1. Time current characteristic tests shall be performed bypassing 300% rated current through each pole separately. Trip time shall be noted. Instantaneous pickup current shall be determined by run up or pulse method. Clearing times should be within 4 cycles or less. At end of test, the thermal breakers shall be set by Contractor. Test Ground-Fault Protection per NEC 230.95.
- 3) Magnetic breakers (MCP), regardless of amperage rating, shall be tested. Instantaneous pickup current shall be determined by run up or pulse method. Clearing time should be within 4 cycles or less. At end of test the breaker trip setting shall be set by Contractor based on the motor locked rotor current.
- 4) Contact resistance shall be measured and be compared to adjacent poles and similar breaker. Deviations of more than 50% shall be reported to Engineer. Insulation resistance shall be measured and shall not be less than 50 megaohms. All trip times shall fall within NETA Table values. Instantaneous pickup current levels should be within 20% of manufacturer's published values.

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COMPANY
DATE

GENERATOR FIELD CHECK LIST

PROJECT NAME: _____
 TESTING COMPANY: _____

DATE OF TEST: _____
 TEST LOCATION: _____

No.	Check box	Description
1	_____	Equipment installed in suitable location?
2	_____	Adequate clearance on all sides to allow ease of maintenance?
3	_____	Proper construction and leveling of mounting base?
4	_____	Anchorage installed per seismic calculations?
5	_____	Adequate heating for equipment room?
6	_____	Battery-powered emergency lighting installed in equipment room?
7	_____	Adequate incoming and outgoing air (louver motors adjusted, tested and of proper voltage)?
8	_____	Radiator duct properly sized and connected?
9	_____	Cooling system properly filled?
10	_____	Proper level of specified oil in crankcase?
11	_____	Adequate fuel supply for test?
12	_____	Flexible sections installed in cooling water lines?
13	_____	Manually-operable fuel and cooling water valves open and ready for operation?
14	_____	Flexible fuel lines installed between engine and fuel piping?
15	_____	Fuel tanks and piping installed in accordance with applicable codes and standards?
16	_____	Adequate fuel transfer tank pump lift and pump motor properly wired?
17	_____	Proper size exhaust line and flexible connector(s)? Flexible connector(s) should not be bent.
18	_____	Exhaust line condensate trap with drain installed?
19	_____	Exhaust line installed with proper downward outgoing incline?
20	_____	Proper-specified muffler installed with hangers and mounts tight?
21	_____	Battery(ies) of proper size and voltage?
22	_____	Battery(ies) filled with electrolyte and properly connected to charger?
23	_____	Battery charger AC circuit properly connected and charger operational?
24	_____	Battery(ies) properly mounted with adequate ventilation?
25	_____	Starting cables of proper length and gauge?
26	_____	Starting cables properly connected to battery(ies)?
27	_____	Generator load conductors of proper ampacity, and properly connected to the correct location?
28	_____	Load conductors, engine start leads, battery and heater power source leads installed and in correct conduits?
29	_____	All other wiring, including customer added options, connected properly?
30	_____	Nameplate voltage and frequency of both generator set and transfer switch matching normal/utility source ratings?
31	_____	Has generator phase rotation been checked versus utility?
32	_____	Transfer switch AC conductors properly connected?
33	_____	Transfer switch switching mechanism free from binding? NOTE: Disconnect all AC sources, and operate manually to check.
34	_____	Generator room clean of all loose material not related to Generator?
35	_____	Exhaust stack protected from entry by rain, snow, and animals?
36	_____	Approved heat-isolating thimble(s) installed at points where exhaust line passes through combustible wall(s) or partition(s)?
37	_____	Exhaust system termination located to prevent entry of exhaust gases into structures?
38	_____	Exhaust line free of excessive bends and restrictions? Back pressure under specified limit?
39	_____	Have all manufacturers' start-up instructions been completed?

NOTES: Before start-up, the Contractor and Generator Supplier must make the following installation checks in addition to those recommended by Generator Manufacturer. Some checks may require a running generator and should be checked immediately during first generator run

This form is intended to be used as a general guide. Use the manufacturer's Operations and Maintenance manual for reference in performing each of the following checks

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SIGNATURE
COMPANY
DATE

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COMPANY
DATE

GENERATOR PERFORMANCE TEST REPORT

PROJECT NAME: _____ DATE OF TEST: _____
 TESTING COMPANY: _____ TEST LOCATION: _____

NAMEPLATE DATA

MANUFACTURER: _____ S/N: _____ KW: _____ KVA: _____
 GENERATOR MODEL _____ S/N: _____ VOLTS: _____ PH: _____
 ENGINE MODEL: _____ S/N: _____
 ALTERNATOR MODEL: _____ S/N: _____

PRELOAD TESTS VOLTAGE MEASUREMENTS

L1 TO L2: _____ L1 TO N: _____ BLOCK HEATER VOLTAGE _____
 L2 TO L3: _____ L2 TO N: _____ BLOCK HEATER WATTAGE _____
 L3 TO L1: _____ L3 TO N: _____ BATTERY VOLTAGE _____

PRELOAD TESTS AND SHUTDOWNS

PRE-ALARMS	INDICATOR LIGHT	SHUTDOWNS	INDICATOR LIGHT	SHUTDOWN FUNCTION
GENERATOR RUN LIGHT	_____	OVERSPEED	_____	_____
ALARM HORN & SILENCE	_____	OVERCRANK	_____	_____
SWITCH NOT IN AUTO	_____	EMERGENCY STOP	_____	_____
PRE LOW OIL PRESSURE	_____	LOW OIL PRESSURE	_____	_____
PRE HIGH ENGINE TEMPERATURE	_____	HIGH ENGINE TEMPERATURE	_____	_____
PRE LOW COOLANT LEVEL	_____	LOW COOLANT LEVEL	_____	_____
PRE LOW FUEL LEVEL	_____	LOW FUEL LEVEL	_____	_____
LOW COOLANT TEMP WARNING	_____		_____	_____
LOW/HIGH BATTERY VOLTAGE	_____		_____	_____
AUXILLIARY FAULT	_____	AUXILLIARY	_____	_____

PERFORMANCE TESTS / LOAD ACCEPTANCE

FULL LOAD	VOLTAGE DIP _____ %	FREQUENCY DIP _____ %
	RECOVERY TIME _____ SEC	RECOVERY TIME _____ SEC
WITH SPECIFIED	VOLTAGE DIP _____ %	FREQUENCY DIP _____ %
MOTOR LOAD	RECOVERY TIME _____ SEC	RECOVERY TIME _____ SEC

LOAD TEST @ 1.0 POWER FACTOR

TIME STAMP	LOAD	VOLTS	AMPS	HZ	KW	AMB °F	WATER °F	OIL PSI	ENGR HRS
WARM UP	0								
0.1	25								
0.1	50								
0.2	75								
0.2	100								
3.4	100								

NOTES:

CERTIFIED BY: _____

SIGNATURE
COMPANY
DATE

WITNESSED BY: _____

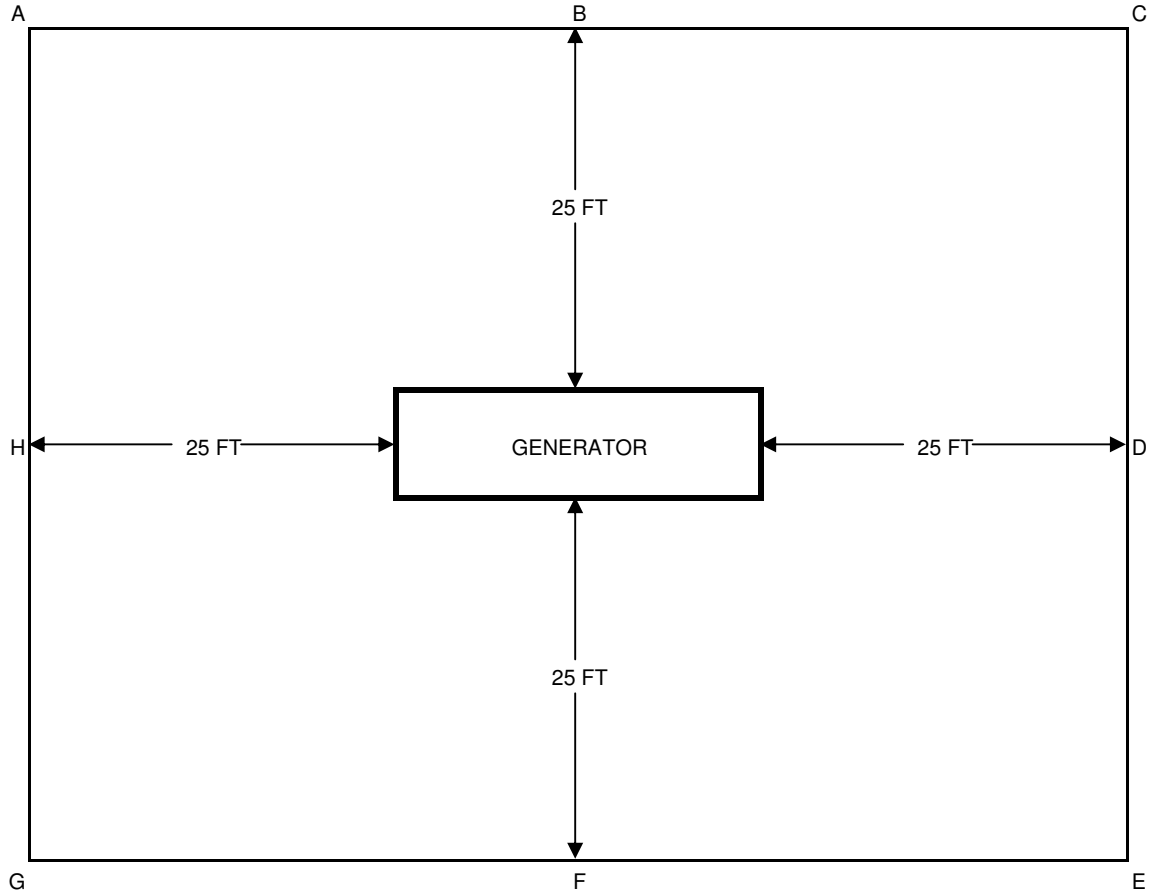
SIGNATURE
COMPANY
DATE

GENERATOR SOUND LEVEL DATA FORM

PROJECT NAME: _____
TESTING COMPANY: _____

DATE OF TEST: _____
TEST LOCATION: _____

SITE CONDITIONS



MEASURED NOISE - LOCATION									
	A	B	C	D	E	F	G	H	
NOT RUNNING									
NO LOAD									
EXPECTED MAX LOAD									
FULL LOAD									

NOTES:

- 1) Note permanent obstructions (within 25 FT) as they exist on site on this drawing.
- 2) Measure sound pressure level (dB) using acoustic sound meter on "A" setting.
- 3) Measure SPL background noise, generator at idle, and at full load.

CERTIFIED BY: _____
SIGNATURE

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SIGNATURE

COMPANY DATE

MOTOR TEST FORM

PROJECT NAME: _____ DATE OF TEST: _____
 TESTING COMPANY: _____ TEST LOCATION: _____
 MOTOR NAME: _____ MOTOR TAG: _____
 SERIAL #: _____

MOTOR NAMEPLATE DATA

MFG: _____ PHASE: _____ TYPE: _____ P.F: _____ S.F: _____ NEMA: _____
 VOLTS: _____ HP: _____ DUTY: _____ RPM: _____ CODE: _____ DESIGN: _____
 FREQ: _____ FLA: _____ MODEL: _____ FRAME #: _____ ROTATION (CW/CCW): _____

INSULATION RESISTANCE TEST PHASE-TO-GROUND/PHASE-TO-PHASE

A: _____ / _____ B: _____ / _____ C: _____ / _____

CONTROL SETTINGS AND TESTS

MOTOR HEATER MEASURED AMPS: _____ (AMPS) MOTOR OVERLOAD SETTING: _____ (AMPS)
 MOTOR THERMAL TRIP TEST: _____ OVERLOAD RESET TEST: _____ (YES/NO)
 MINIMUM SPEED (IF VFD): _____ (HERTZ) COIL RESISTANCE: AB BC CA

PHYSICAL MOTOR TESTS - ACTUAL MEASURED VALUES

VOLTAGE (VOLTS)	AMPERAGE (AMPS)	POWER
AB: _____ V	A: _____ A	POWER FACTOR: _____
BC: _____ V	B: _____ A	POWER DRAW: _____ KW
CA: _____ V	C: _____ A	HORSEPOWER: _____ HP
IMBALANCE: _____ %	IMBALANCE: _____ %	

NOTES:

- 1) Perform coil resistance measurements on motor leads with a low-resistance ohmmeter. Note measurements.
- 2) Perform insulation-resistance test utilizing 500 volt megger and/or accordance with manufacturer's published testing procedures. Motors 200 HP and more test duration 10 minutes, 200 HP and less test duration 1 minute.
- 3) Perform DC overpotential tests on motors rated 1000 HP and 4000 volts or greater in accordance with ANSI/IEEE Standard 95.
- 4) Verify that pump/shaft seals are lubricated and that automated lubrication systems are functional.
- 5) Verify that motor protection/monitoring circuits are installed and connected per contract drawings and manufacturer requirements.
- 6) Verify that the motor space heater is functional.
- 7) Perform a rotation test to insure correct shaft direction by "bumping" motor. Reverse as necessary in appropriate place. Phase taping must remain in order on terminals left-to-right once completed.
- 8) Measure running current and evaluate relative to load conditions and nameplate full-load amperes.
- 9) Record the voltage and current on all phases while operating under full-load. If voltage or current imbalance is above 2 percent, or if current is above nameplate FLA or expected level, investigate cause and report on findings. Calculate imbalance by dividing (high minus low measurement) by the average measurement of all 3 phases.
- 10) Vibration tests shall be conducted in cases of discernable abnormal vibration or when ordered by the Engineer (due to perceived excessive vibration). Vibration shall not exceed 0.1 in./sec as measured opposite driven end of motor. Make necessary corrections to reduce vibration below limit at all operational speeds and loads.

COMMENTS:

CERTIFIED BY: _____

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COMPANY
DATE

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SIGNATURE
COMPANY
DATE

HARMONIC MEASUREMENT TEST FORM

PROJECT NAME: _____
 TESTING COMPANY: _____
 TECHNICIAN: _____
 POINT OF MEASUREMENT: _____

DATE OF TEST: _____
 TEST LOCATION: _____
 EQUIPMENT NAME: _____

(If available, take measurements on primary side of main breaker, otherwise, on secondary side of main breaker.)

COMMENTS:

MEASURED HARMONIC VOLTAGE VALUES												
RUNNING CONDITION			TIME	VOLT	AMPS	THD(V)	THD(A)	5TH	7TH	11TH	13TH	15TH
PUMP 1 SPEED	PUMP 2 SPEED	PUMP 3 SPEED										
0	0	0										
70	0	0										
90	0	0										
100	0	0										
70	70	0										
90	90	0										
100	100	0										
70	70	70										
90	90	90										
100	100	100										

NOTES:

- 1) Measure the harmonics with a harmonic analyzer with each combination of pumps shown or as designated by Engineer at start-up in operation on the Utility source. Repeat test on generator (if applicable).
- 2) Use multiple forms and/or attach printouts of harmonic analyzer machine.
- 4) Expand this chart for pump stations/systems with more than 3 VFD pumps.
- 5) All harmonic conditioning equipment shall be on-line and operate other non-VFD loads as normal during test.

CERTIFIED BY: _____
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 COMPANY

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SIGNATURE

 COMPANY

 DATE

PROGRAMMABLE LOGIC CONTROLLER I/O POINT-TO-POINT TEST FORM

PROJECT NAME: _____
 TESTING CO: _____
 PANEL NAME: _____
 PLC NAME: _____

DATE OF TEST: _____
 TEST LOCATION: _____
 PANEL TAG #: _____
 RACK # _____ SLOT # _____ I/O TYPE _____

I/O POINT				Scale					Digital	Operator	SCADA	Pass/Fail
I/O #	TYPE	TAG #	Description	@4mA	@8mA	@12mA	@16mA	@20mA	On/Off	Interface	Screen	CM or R
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												

- NOTES:
- 1) Connect signal generator to each I/O point for factory testing.
 - 2) Utilize actual instrument to generate signals for field pre-operational tests where possible.
 - 3) Verify function and accuracy of loop by switching the digital signal or modulating the analog signal from the connected device or instrument
 - 4) Field verify all instruments and indicators within loop of signal.
 - 4) Confirm polarity of signals and calibration ranges are equivalent for all components in loop.
 - 5) Include significant digits past decimal in scale columns
 - 6) Complete checklist above by entering a checkmark (CM) for acceptable, or R for needs repair or attention
 - 7) Note items that need attention below

Attention Required:

CERTIFIED BY: _____
SIGNATURE

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INSTRUMENTATION SWITCH CALIBRATION TESTS FORM

PROJECT NAME: _____
 TESTING COMPANY: _____
 INSTRUMENT NAME: _____
 INSTRUMENT UNITS: _____
 TYPE: _____
 SERIAL #: _____

DATE OF TEST: _____
 TEST LOCATION: _____
 INSTRUMENT TAG#: _____
 NAME: _____
 MODEL: _____

MANUFACTURER			INSTRUMENT		
NAME: _____ TYPE: _____ MODEL: _____ SERIAL #: _____			UNITS: _____		
PROCESS SETPOINT	INCREASING TRIP POINT	DECREASING TRIP POINT	DEADBAND	SETPOINT TIME DELAY	ACTUAL TIME DELAY

NOTES:

- 1) Field test instrumentation and associated control systems in accordance with the specifications and the manufacturer's instructions. Instrumentation shall function as intended under actual process conditions or shall be repaired or replaced at Contractor's expense.
- 2) Complete a separate calibration form for each instrument provided.
- 3) Simulate process variable in field by applying known pressure, temperature, opening/closing measured device, raising/lowering actual level, etc. as required to confirm calibration. This step must be witnessed by inspector.

CERTIFIED BY: _____
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DATE

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COMPANY
DATE

INSTRUMENTATION TRANSMITTER CALIBRATION TEST FORM

PROJECT NAME: _____
 TESTING COMPANY: _____
 INSTRUMENT NAME: _____

DATE OF TEST: _____
 TEST LOCATION: _____
 INSTRUMENT TAG#: _____

MANUFACTURER				INSTRUMENT			
NAME: _____				RANGE: _____			
TYPE: _____				SCALE: _____			
MODEL: _____				UNITS: _____			
SERIAL #: _____				TRANSMITTER OUTPUT: _____			
REMOTE SENSOR TYPE: _____ (If Applicable)				FACTORY SPECIFIED ACCURACY: _____			
				REMOTE SENSOR OUTPUT: _____ (If Applicable)			
DESIGNED VALUE				ACTUAL VALUE			
INPUT SIGNAL	OUTPUT	ENG VALUE	CALCULATED TOLERANCES	INSTRUMENT DISPLAY	INSTRUMENT OUTPUT SIGNAL	PROCESS INDICATOR	LOGIC VALUE

NOTES:

- 1) With this form, attach and submit factory calibration forms for flowmeters and transmitters that are available from factory.
- 2) Field test and calibrate instrumentation and associated control systems in accordance with the specifications and the manufacturer's instructions. Instrumentation shall meet specified accuracy or shall be repaired or replaced at Contractor's expense.
- 3) Complete a separate calibration form for each instrument provided.
- 4) Simulate process variable in field by applying known pressure, temperature, pH, etc. as required to confirm calibration. This step must be witnessed by inspector.
- 5) Provide parameter value for each parameter changed from factory default.

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PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Short Circuit Study.
- B. Protective Device Coordination Study.
- C. Arc Flash Study and labeling.
- D. Labor, materials, equipment, tools, safety gear, test equipment, incidentals, services, and transportation to complete the work and implement the conclusions.
- E. Analysis shall be prepared utilizing electrical systems analysis software with all calculation modules within the same program. Analysis software shall be SKM Power Tools, Easy Power, or approved equal.
- F. Study shall be prepared by or under the direct supervision of a California registered Electrical Engineer and bear that engineer's seal and signature.
- G. Work includes analysis of all electrical equipment in the facility, new and existing; i.e. buses, circuit breakers, main switchboards, motor control centers, conductors, fuses, etc. Collect field data, coordinate with Utility, and document new and existing conditions as required for a thorough system analysis.
- H. Work includes that specified in Electrical Specifications [Electrical General].

1.02 SUBMITTAL REQUIREMENTS

- A. Provide submittals and drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].
- B. Submittals shall be provided in multiple steps:
 - 1. Included with first electrical equipment submittal but under separate cover. Purpose will be to confirm selected equipment meets requirements for interrupt capacity and is able to be coordinated.
 - 2. Included with subsequent electrical equipment submittals but under separate cover. Comments and changes related to electrical equipment shall be incorporated.
 - 3. Two weeks prior to equipment start-up. Final wire lengths, and other information related to actual field installation shall be incorporated. New or revised utility information as it exists. Order/furnish equipment labels upon approval of study.
- C. Submit input data and reports generated by analysis software for review after approval of power distribution equipment but prior to procurement. Submittal shall include, but not limited to;
 - 1. Load Flow drawing and analysis with voltage and current at each node.
 - 2. Fault drawing and analysis with incident energy shown at each node.
 - 3. Time-Current Curve and Coordination
 - 4. Settings Table
 - 5. Arc Flash and incident energy table
 - 6. Arc Flash warning labels (printout)

- D. Changes to electrical equipment required due to selective coordination requirements will need to be implemented prior to procurement of the power distribution equipment.
- E. Submit system model in native software file format for use by the City when performing modifications in future years.

PART 2 PRODUCTS

2.01 GENERAL

- A. Perform study(s) using the latest version of electrical analysis software created specifically for this purpose. Program name and version shall be clearly stated within report.
- B. The coordination study shall begin at the utility company's connection and include all of the electrical protective devices down to and include the largest feeder circuit breaker and motor starter in the 480 Volt motor control centers and power distribution panelboards. The study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers, and all protective devices.
- C. Obtain utility source information for proper modeling of source supply.
- D. Perform and provide fault calculations for each power source, and every possible switched configuration.
- E. Input electrical equipment individually into the program, not as groups. All electrical equipment shall be included.
- F. Utilize equipment / component tag names and numbers where shown. Follow similar standards when naming equipment without defined tags.
- G. Obtain manufacturer data from submittals provided by vendors and integrators on the project and from the Utility Company directly. The Owner and Engineer are not responsible for providing information.
- H. Provide time-current curves (TCC) diagrams for all protective equipment and breakers. Provide trip settings for each circuit breaker on the TCC diagram.
- I. Protective device settings shall be applied prior testing and start-up of electrical equipment.

2.02 SHORT CIRCUIT STUDY AND LOAD FLOW ANALYSIS

- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standards 141, latest edition.
- B. Transformer design impedances and standard X/R ratios shall be used when test values are not available.
- C. Short circuit study shall provide the following information:
 - 1. Bus impedances.
 - 2. Transformer impedances based on actual submittals or ANSI standards.
 - 3. Cable length, impedance, size, type, and quantity.

4. Utility data:
 - a. Transformer KVA, impedance, voltage.
 - b. Primary voltage of Utility transformer.
 - c. Utility Company primary fault currents (Min, Max, normal values), three phase bolted, line to ground, X/R ratio (positive sequence) and X/R ratio (zero sequence).
- D. Voltage and current at each node within the system.
- E. Protective relay model and settings.
- F. Calculate Short Circuit fault currents for three-phase bolted fault and line-to-ground fault at each node including the following.
 1. Incoming Utility
 2. High / Medium / Low voltage switchgear
 3. Power transformer primary and secondary
 4. Switchboard
 5. Motor Control Centers (MCCs)
 6. Panelboards
 7. 480V, 3 phase motor and equipment loads 2 HP and larger
- G. Compare ratings of transformers, cable, equipment, and protective devices to the calculated short circuit stresses. Note any areas or equipment that may be deficient.
- H. Provide Short Circuit and Load Flow study report showing the following minimum information.
 1. Assumptions
 2. Input data to program
 - a. Circuit diagrams (conductors, circuit disconnects, transformers, panelboards, main switchboards, generators, transfer switches, buses, etc.)
 - b. Symmetrical and asymmetrical line-to-line and line-to-ground fault currents.
 - c. Impedances
 - d. X/R ratios
 - e. Motor contributions
 3. Equipment evaluations (protected and non-protected devices) showing ratings, manufacturer, status, equipment type, and calculated minimums.
 4. Bus rating of equipment.
 5. Electric Utility company data.
 6. Results, conclusions, and recommendations.

2.03 PROTECTIVE DEVICE COORDINATION STUDY

- A. Provide Protective Device Coordination drawings for each section of distribution system.
- B. Provide coordination time-current curves (TCC) on conventional log-log curve sheets. Each time-current curve shall be labeled to identify its purpose. This identifier shall be used in the tabulated settings spreadsheet and on the associated one-line diagram.
- C. Provide the following curves (minimum):
 1. 12 kv distribution system, relay, fuses, cable, etc.
 2. Transformer, circuit breakers, and motor loads

- D. Partial one-line diagram of specific portion of distribution system associated with time-current curves in question. One-line diagram shall include the following:
 - 1. Coordination name identifier – usually the protected device.
 - 2. Voltages, amperages, impedance and node names.
 - 3. Circuit devices such as transformers, cables, breakers, fuses, etc. with their corresponding amperage, KVA, and HP ratings.
- E. Show maximum fault current to which device is exposed as calculated in short circuit study.
- F. Characteristics plotted on TCC diagrams shall include; but, not be limited to:
 - 1. Protective relays.
 - 2. Fuses including melting curve, tolerance, and damage bands.
 - 3. Circuit breaker trip with tolerance bands.
 - 4. Transformer full-load and magnetizing current.
 - 5. Transformer and cable damage curves.
 - 6. Transformer withstand parameters ANSI.
 - 7. Motor and equipment full load currents.
 - 8. Ground fault protective device settings.
 - 9. Other electronic protective devices.
- G. Provide the following recommended settings in spreadsheet format in the Protective Device Coordination study report:
 - 1. Relay settings including CT values.
 - 2. Circuit Breakers adjustments:
 - a. Long trip amperage and delay.
 - b. Short trip amperage and delay.
 - c. Instantaneous trip amperage.
 - d. Ground trip amperage and delay.
- H. Settings for all configurable electronic motor starters and VFDs.
- I. Provide settings for settable circuit breakers and MCPs. Provide settings according to actual equipment installed.
- J. Identify each curve by description, manufacturer, function, amperage and model as necessary to distinguish it from others.

2.04 ARC FLASH HAZARD STUDY

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E including annexes.
- B. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.
- C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway, and splitters) where work could be performed on energized parts.
- D. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary for incident energy of 1.2 cal/cm² or greater.

- E. Provide Arc flash calculation on line and load side of main breaker if there are serviceable components in a main breaker compartment.
- F. Provide a table with the following parameters in the Arc Flash Hazard study report:
 - 1. Arc fault magnitude
 - 2. Device clearing time and/or arc duration
 - 3. Arc flash boundary
 - 4. Incident energy
 - 5. Working distance

2.05 STUDY REPORTS

- A. Reports shall contain:
 - 1. Description of studies performed and brief introduction.
 - 2. Report calculations and spreadsheets results.
 - 3. Selected equipment deficiencies.
 - 4. Short circuit and coordination studies results.
 - 5. Comments or suggestions to improve safety:
 - a. Changes and additions to equipment rating and/or characteristics.
 - b. Highlight any equipment or devices that are deficient.
 - 6. Protective device settings:
 - a. Breaker Frame make and model
 - b. Trip unit make and model number
 - c. Long, Short, Instantaneous, and Ground settings
 - 7. Stamped, signed and dated by Electrical Engineer registered in the State of California who performed the analysis.
 - 8. Reports are to be updated to reflect as-built conditions at the end of the project to reflect change orders and other changes that have taken place since submittal.

PART 3 EXECUTION

3.01 GENERAL

- A. Perform settings to equipment as required to obtain conformance with the Short Circuit and Protective Device Coordination Studies.
- B. Submit as-built Power System Analysis report and project in PDF and native software file format for future use by the OWNER. Furnish all files needed to re-create the report.

3.02 FIELD QUALITY CONTROL

- A. Test all protective devices as specified in section 16600.
- B. Submit with any related field changes with final copies of studies and documentation.
- C. 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 labels.

3.03 ADJUSTING

- A. After review and acceptance of the recommend settings, the supplier’s field service technician shall set all recommended settings according to values determined during coordination Study.
- B. Install arc-flash hazard labels on all equipment covered by the study.

3.04 ARC FLASH WARNING LABELS

- A. Labels shall comply with latest codes and standards as they frequently change and the latest information may not be reflected here.
- B. Provide minimum 3.5in. x 5in. Polyester with polyvinyl polymer over-laminate, self-adhesive warning sticker for each work location analyzed. Labels shall be resistant to:
 - 1. UV Rays
 - 2. Chemicals and common cleaning solvents
 - 3. Scuffing
 - 4. Wide temperature changes
- C. Each label shall have a header with the wording, “DANGER (red) or WARNING (orange) - ARC FLASH HAZARD”, and shall include the following machine printed information:
 - 1. Location designation
 - 2. Nominal voltage
 - 3. Flash protection boundary
 - 4. Incident energy
 - 5. Working Distance
 - 6. Minimum Arc Rating of Clothing and other PPE
 - 7. Engineering report/issue date and revision number
- D. Labels shall be professionally manufactured, machine printed, and not be hand-made and/or hand marked.
- E. After review and acceptance of the Arc Flash hazard submittal and/or report 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. Provide label for line and load sides of main.
 - b. The front of each low voltage switchgear section.
 - c. The front of each medium voltage circuit breaker door.
 - d. Each motor control center compartment displaying hazard below the circuit breaker when energized.
 - e. Each panelboard covered by the study.
 - f. Each control panel, individual starter, VFD or other equipment covered by the scope of the study.

END OF SECTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide and install Control Panels, Terminal Panels, and custom specific purpose panels per Drawings and Specifications.
- B. Provide complete wired and tested panel with all devices installed per the contract Drawings and as stated herein.
- C. Provide all necessary hardware, conduit, wiring, fittings, and devices to connect the control panel to equipment provided under other Sections.

1.02 REFERENCES

- A. Electrical Specifications [Electrical General].
- B. Electrical Specifications [Low Voltage Wire & Data Cable]
- C. Electrical Specifications [PLC & OI Hardware]
- D. Electrical Specifications [PLC & OI Application Programming]
- E. Electrical Specifications [Instrumentation]

1.03 SUBMITTAL REQUIREMENTS

- A. Provide submittals and Drawings as specified in Electrical Specifications [Electrical General, Submittal Requirements].
- B. Submit shop construction Drawings for the Control Panel. The following Drawings shall be provided as a minimum:
 - 1. Scaled drawings of the Control panel elevation, baseplan. The dimensions and locations of the cutouts shall be dimensioned from the bottom left corner of the door(s).
 - 2. Scaled drawings of the backpan including all mounted components and wireways.
 - 3. Wiring diagrams for AC and DC power distribution, I/O for each card in the PLC and communications block diagrams.
- C. Calculations for environmental controls. Environmental controls (including air conditioners, exhaust fans, heaters and circulation fans) shall maintain interior panels temperatures within ratings of all internal equipment given the intended installation location.
 - 1. Design and install environmental control systems to meet requirements herein and prevent premature failure of panel internal components.
 - 2. Environmental controls may be shown in the Drawings and shall be considered the minimum level required. Additional components or systems shall be provided to meet internal temperature requirements.
 - 3. Environmental control systems shall prevent and control intrusion of dust and bugs through the use of filtration systems.

4. Environmental control systems shall maintain humidity below that of the external ambient air and without condensation within panel.

1.04 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Provide operating instructions as specified in Electrical Specifications [Electrical General].

PART 2 PRODUCTS

2.01 ENCLOSURE

- A. The enclosure for the control panel shall be (at minimum) sized as shown in the Contract Drawings.
 1. Arrangement: Where so indicated, the instruments mounted in the panels shall have the nominal size and general arrangement shown. Panel layouts and nameplates shall conform to the approved submittal.
 2. Assembly: Mount all equipment on 12 ga. painted white backpan(s) that is bolted to rear (and sides) of the enclosure. Use drill and tap method for machine thread screws for all internal components on mounting panels. Provide extra mounting bolts through the rear of the structure if equipment weight exceeds backpanel mounting stud capacity.
 3. Hardware: Provide door latch and accessories as detailed in the Contract Drawings or as required to meet NEMA area ratings.
 - a. Provide one or two single point latches for panels up to 36" height.
 - b. Provide 3 point latching mechanisms for panels over 36" height consisting of rotating handle with latch, extension bars with plastic wheels at ends and guide slots at top and bottom of door, or as otherwise shown on drawings.
 - c. Hinges, pins, bolts and screws shall be of 316 stainless steel only.
 4. When physical size requirements for individual components are different than that detailed on the Control Panel backpan drawing, the wiring diagrams and specifications herein shall supersede the elevation drawing and the Contractor shall furnish additional panel width as needed to fit the electrical equipment. Deviations with sufficient evidence for the change shall be submitted for approval. The Contractor is required to provide for all equipment including spares and spaces as shown in the wiring diagrams.
 5. The control pedestal enclosure shall be as required per Drawings and custom manufactured by Saginaw, Hoffman, Tesco or equal.

2.02 CONTROL PANEL CIRCUIT BREAKERS

- A. Furnish circuit breakers and accessories as required per Drawings and application.
 1. Copper busbar systems, up to 480VAC, 115A, 1, 2 or 3 phase as needed for application
 2. Trip rating per Drawings or as needed for protected device. Trip curves as selected by System Integrator.
 - a. B curve magnetic trip point: 3 to 5 times the rated current, typically used for computers and electronic equipment with very low inrush loads (PLC wiring).
 - b. C curve magnetic trip point: 5 to 10 times the rated current, typically used for small transformers, pilot devices, etc.
 - c. D curve magnetic trip point: 10 to 20 times the rated current, typically used for transformers or loads with very high inductive loads.

3. Quantity of pins and feed in lugs as required.
4. Auxiliary contact, shunt trip as required in Drawings.
5. DIN rail mounted, 18mm width per pole, finger safe pressure plate terminals.

B. Motor applications:

1. UL489 for branch circuit protection up to 40A, 1 to 3 pole.
2. 5 kAIC interrupting capacity @ 480 VAC
3. Alltech, Eaton FAZ, or equal.

C. Control circuit transformers and other Non-motor applications:

1. UL1077 supplementary protection up to 63 amps, 1 to 2 pole, AC or DC.
2. Used where a UL489 protective device is upstream powering the circuit (from a panelboard or other source).
3. Used within control circuits for power supplies, control power transformers, relays and PLC I/O points.
4. Used in place of fuses that are applied as supplementary protection.
5. Eaton FAZ, or equal.

2.03 FUSES AND FUSE HOLDER

- A. Fuses shall not be used in branch or control circuits unless specifically shown in the Drawings. Circuit breakers shall be furnished and utilized where possible.
- B. Fuses used in circuits 200 VAC and above shall be time delay, 13/32" x 1 1/2", and have an interrupting rating of 10,000 AIC at 500 VAC. Fuses shall be Bussman type FNQ or approved equal. Fuse holders shall feature open fuse indication lights and shall be rated 30A at 600 VAC. Fuse holders shall be Bussman Optima Series OPM or equal.
- C. Fuses used in 120 VAC shall be time delay, 1/4" x 1 1/4", and have a rating of 250 VAC. Fuses shall be Bussman type MDA or approved equal. Fuse holders shall be of the same manufacturer, series and color as the adjacent terminal blocks and have blown fuse neon indicators. Fuse holders shall be Entrelec ML 10/13.SFL, Allen Bradley 1492-H4 or equal.
- D. Fuses used in signal and 24 VDC circuits shall be fast acting, 5mm x 20mm and have a rating of 250 VAC. Fuses shall be Bussman type GMA or approved equal Fuse holders shall be of the same manufacturer, series and color as the adjacent terminal blocks and have blown fuse LED indicators. Fuse holders shall be Entrelec M 4/8.SFDT, Allen Bradley- 1492-H5 or equal
- E. Fuses shall be sized in conformance with the NEC.

2.04 TERMINAL BLOCKS AND ACCESSORIES

A. General

1. Terminal blocks to be clamp type, 5 spacing, 300 volt, minimum rating of 20 amps, and mounted on DIN rail. DIN rail shall be same type as used for the relays. Install extra DIN rail on each type of terminal strip with 10% spare terminals for future additions.
 - a. Provide larger terminal as necessary based on gauge of connected wiring. Those terminals with 10 gauge larger gauge wiring or more than one 12 gauge wire should be evaluated and changed.
2. Provide terminal blocks with "follower" plates that compress the wires and have wire guide tangs for ease of maintenance. Terminal blocks that compress the

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wires with direct screw compression are unacceptable. All power, control and instrument wires entering and leaving a compartment shall terminate on terminal blocks with wire numbers on terminals and on both ends of the wires.

3. Provide end clamps, separators, din rails, and jumpers to complete terminal block system. See example PLC I/O drawing for additional information. Engineer can provide on request if not available in plans.
4. Terminal Tags and Markers: Each terminal strip shall have a unique identifying alphanumeric code at one end (i.e.: TB1, TB2, etc.) or as shown in Drawings.
5. Plastic marking tabs shall be provided to label each terminal block. These marking tabs shall have a unique number/letter for each terminal which is identical to the "elementary" and "loop" diagram wire designation. Numbers on these marking strip shall be machine printed and 1/8" high letters minimum.
6. Terminal blocks shall be physically separated into groups by the level of signal and voltage served an by PLC I/O card. Power and control wiring above 100 volts shall have a separate group of terminal blocks from terminal blocks for wiring below 100 volts, intermixing of these two types of wiring on the same group of terminal blocks is not allowed.
7. Terminal blocks shall be gray in color unless otherwise shown on the Drawings.
8. Provide a ground terminal or connection point for each grounding conductor.
9. Provide a separate signal, common, and/or neutral terminal for every wire and PLC or remote device connection at minimum.

B. CP – Control Panel Terminal Blocks

<u>Description</u>	<u>Model number, Allen Bradley or equal</u>
General Purpose Terminal Block, 20A	1492-W3
Disconnecting Terminal Block, 20A	1492-JKD3
Grounding Terminal Block	1492-JG4
PLC AI Sensor Block, 3 Level. Use upper terminal for AI +/- and lower blocks for 24+ and 24-	1492-WTS3 (2 per AI)
PLC Digital Output Relays, 120VAC, 6A, SPDT	700-HLT1U1

Note 1: General purpose relays are defined in ELECTRICAL – GENERAL

Note 2: Utilize two terminal blocks for each AI. Upper terminal shall be the analog signal, the middle block shall be 24v +, and the lower terminal shall be 24v -. Buss each terminal 24+ to each other, and buss each 24 – to each other utilizing terminal jumpers (copper finger buss or center screw type)

Note 3: Accessories are not listed such as end caps, anchors, jumpers, bridges, marking strips, or other items necessary to make up a complete terminal block layout. Furnish all parts necessary per manufacturer’s intended solution.

C. MCC – Motor Starter Cubicle Terminal Blocks

1. MCC cubicle terminal blocks shall be pull apart as supplied standard by MCC manufacturer.

D. Power – Power terminal Blocks

1. Backpan mounted termination blocks shall be rated for 600V (min). The power termination blocks shall be rated to accept Copper or Aluminum cable and rated as shown on Contract one-line diagrams. Termination blocks shall be insulated with molded plastic covering and finger safe cover. Each termination block shall be provided with quantity and size of primary and secondary cable connections

as required per installation. The power termination blocks shall be Erico UD, UDJ, BD, TD, or SB series or equal.

2. Unmounted termination blocks shall be constructed of aluminum and suitable for use with Aluminum and copper wire. Size and quantity of cable connections shall be as required for installation. Termination blocks shall be insulated with molded high-dielectric strength plastic covering and eliminate the need for tape insulation of electric connection. The termination block shall have removable access plugs over the wire entry and hex screw ports. Provide NSI Polaris IPL or IPLD Series terminal blocks or equal.

E. Panel Receptacles

1. Ground fault circuit interrupter receptacles shall be used where shown for convenience use. Dedicated receptacles for equipment may be standard duplex outlets. GFI and standard receptacles shall be commercial grade, duplex, ivory, 20A, 120V, back and side wired. Furnish Leviton, Hubbel, or equal.

F. Panel Ground

1. Each electrical enclosure shall have a copper ground bus. Screw type fasteners shall be provided on all ground busses for connection of grounding conductors. Ground bus shall be a Challenger GB series, ILSCO CAN series or equal.
2. A 12ga. copper ground wire shall be attached between the ground bar and the panel enclosure, and between the ground bar and the mounting panels. The ground connection to the enclosure and panel shall be made by sanding the paint finish off a small area, drilling a hole for a 0.25 inch bolt and mounting a 0.25-20 bolt to the panel to serve as grounding stud. The grounding stud shall be attached with a nut and flat washers on both sides of the enclosure/panel, and with an inside tooth star lock washer next to the panel surface. The star lock washer shall be on the inside surface of the enclosure, and the front surface of the mounting panel. The grounding wire shall be secured to the stud with a nut and inside tooth star lock washer. These grounding points shall be located within 12 inches of the bottom to the grounding bar. Each terminal strip rail shall be individually grounded by means of a #12 AWG wire to the ground bus.
3. Components within the panel shall be grounded according to the manufacturer's recommendations.

2.05 POWER SUPPLIES

A. Uninterruptible Power Supply (UPS)

1. The UPS shall be installed within the control panel and power all process related 120 VAC devices and DC power supplies.
2. The UPS capacity/size shall be as shown in the contract Drawings. The battery capacity shall be such that it may provide nameplate power for 10 minutes (min) from a fully charged battery(s).
3. The UPS shall provide surge protection and filtering: 0.3% IEEE surge let-through, zero clamping response time to meet UL 1449. The inverter shall provide true sine wave output.
4. When the Utility power voltage is outside of a preset range (approx. $<100 < V < 130$ VAC) then the UPS shall power the load from storage batteries and a solid state inverter.
5. The power supply shall be wired into the control panel power circuit per the contract Drawings.
6. The UPS operating ambient temperature range shall be 32 deg F to 122 deg F minimum.

7. The inverter shall be self resetting and continuously on-line regardless of the Utility power existence. Configure the UPS to restart automatically upon restart of utility power without operator intervention. The rectifier/charger shall recharge and maintain float charge on the batteries automatically.
 8. The UPS shall be of a readily available commercial manufacturer. Provide American Power Conversion Smart UPS, or equal.
- B. DC Power Supply (PS)
1. The DC power supply shall utilize a switching power stage, rectifier and voltage regulator. The power supply case shall be DIN rail mountable.
 2. The power supply shall operate on 120V AC and provide DC output voltage and current as shown in the Contract Drawings.
 3. The power supply shall be wired and fused per manufacturer instructions and Contract Drawings. Power supply output shall include self resetting overcurrent protection.
 4. Power supplies below 101 Watts output power shall be Class 2 rated.
 5. The power supply shall provide 2% voltage regulation for a change of 10% load to 100% full load.
 6. The DC power supply shall be IDEC PS5R Series (non-redundant applications), Sola SDN-C, Phoenix Contact Quint Power, or equal.

2.06 MISCELLANEOUS COMPONENTS

- A. Wireway: Manufactured from light gray rigid PVC suitable for continuous use at temperatures up to 50 deg C. Wireway shall be 2" height, width as required with 0.5" slot spacing with removable covers. Provide Panduit type "F" or equal.
- B. LED Strip Light: The LED light shall be an "under cabinet" style with multiple LED lamps and acrylic diffuser. Lamp shall be switched on/off from integral switch or PIR motion sensor. Light housing shall be capable of magnet mount to top or side of enclosure or will include mounting tabs for mounting to brackets. Lamp shall be powered from 120VAC or from 24~48 VDC or shown in the contract Drawings. LED Strip Light shall be Stego 02540, or equal.
- C. Circulation Fans: The control panel temperature shall be maintained 10 deg. F below lowest internal device's temperature rating. The fans shall be 4" or 6" unless otherwise noted on Contract Drawings. The Contractor shall calculate the heat generation of all internal components and determine if the fans submitted will meet the cooling requirements of the internal components. Circulation fans shall include louver with filter and bug screen for outdoor installations.
- D. Forced Air Heater: The control panel temperature shall be kept above 50 deg. F through the use of a resistive forced air heater when the panel is located outdoors. The heater shall contain a fan, heating elements, and thermostat within a single self contained unit. The wattage of the heater shall be as calculated by the supplier using the manufacturers sizing method to meet the temperature requirements. The heater shall be Hoffman D-AH series, or equal.
- E. Thermostats: The air circulation fans shall be controlled by adjustable thermostat. The thermostat shall be mounted near the top of the panel and easily accessible by a technician. The thermostat shall be capable of control of a heater or cooling fan(s) by selecting the proper contact logic. The thermostat range shall be adjustable from 30 to 140 deg F. Thermostat shall be Hoffman A-TEMxx, or equal.

PART 3 EXECUTION

3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

3.02 FABRICATION

- A. Equipment Mounting:
 - 1. Mount all equipment using manufacturers mounting tabs/holes or brackets where possible. Where not possible, construct custom brackets to panel mount or backpan mount components as shown in the Contract Drawings.
 - 2. Equipment or laptop shelves shall be provided where shown on the Contract Drawings. Equipment shown on shelves shall not be placed on the bottom of the panel after field installation.
 - 3. All nuts, bolts, screws, washers and hinges used in the panel shall be stainless steel. All components shall be mounted using bolts or screw fasteners only which are drilled and tapped into the backpan. Pop rivets shall not be allowed within panel except for enclosure support arms.
- B. Environmental:
 - 1. Control panel environmental accessories including fans, louvers, filters, bugscreens, air conditioners, etc. shall be provided as noted in the Drawings and as necessary for a complete environmental solution.
 - 2. Panels environmental controls shall be designed during shop drawing submittal and fabricated to maintain temperatures 10 degrees F below lowest internal equipment maximum temperature rating.
 - 3. Contractor shall provide [additional] fans, louvers, screens, sunshades, air conditioners, etc. as necessary to prevent equipment malfunction or premature failure. Provide associated wiring and thermostats as needed.
 - 4. Environments:
 - a. NEMA 4X rated panels shall be cooled/heated with closed loop type conditioning systems to include air conditioners, internal panel circulation fans and resistive heaters.
 - b. NEMA 3R rated outdoor panels shall be cooled/heated with open loop type conditioning systems to include air conditioners, exhaust fans and louvers, internal panel circulation fans and resistive heaters. All exhaust fans and louvers shall include filters and bugscreens.
 - c. NEMA 12 or 1 rated indoor panels shall be cooled/heated with open loop type conditioning systems to include air conditioners, exhaust fans and louvers, internal panel circulation fans and resistive heaters. All exhaust fans and louvers shall include filters and bugscreens.
- C. Wiring:
 - 1. Panel Wiring: All wiring shall be installed in wireways between terminal blocks, PLC, and devices. Reference Contract Drawings for control panel power distribution diagram and control panel elementary diagrams.

3.03 INSTALLATION

- A. Wiring:
 - 1. Install all equipment per Electrical Specifications [Electrical General].

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2. All internal and field wiring shall be per Electrical Specifications [Low Voltage Wire].
3. Panel Wiring: All wiring shall be installed in wireways between terminal blocks and devices. Reference Contract Drawings for Control panel power distribution diagram and control panel elementary diagrams.
4. Field Wiring: Wireways shall be provided for field wiring. Reference Contract Drawings for control panel power distribution diagram and control panel elementary diagrams.

B. Cleaning:

1. The Contractor shall clean the inside of the control panel of any dust or debris remaining at the completion of installation and testing.
2. The Contractor shall exercise care when using a vacuum cleaner or compressed air such as not to damage any component within the panel.
3. Many electrical and computer components are open for ventilation. Falling debris can penetrate the openings and cause equipment failure. Equipment with debris inside shall be removed, cleaned and/or replaced.

3.04 FIELD ASSISTANCE

- A. Provide testing as specified in Electrical Specifications [Factory and Field Testing].

3.05 WARRANTY

- A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

3.06 FINAL ACCEPTANCE

- A. Final Acceptance per Electrical Specifications [Electrical General].

END OF SECTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Providing and installing Programmable Logic Controller (PLC) and Operator Interface Hardware and all supporting hardware, wiring and devices as specified in Electrical Specifications.

1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Electrical Specifications [Low Voltage Wire and Data Cable]
- C. Electrical Specifications [PLC and OI Application Programming]

1.03 SUBMITTAL REQUIREMENTS

- A. Provide submittals per Electrical Specifications [Electrical General, Submittal Requirements].
- B. Submit documentation showing the number and type of I/O modules required to meet the I/O requirements specified herein. Include complete manufacturer's part and model numbers.
 - 1. PLC I/O points are determined by the P&ID Drawings. The Contractor shall count and total the PLC I/O points per PLC controller and per type of I/O required based on the P&ID diagrams. Provide 25% spare I/O points per I/O type per PLC.
- C. Submit calculations showing that the power supply meets the specified requirements and the requirements of the devices powered. Confirm PLC power supply is sufficient for all possible operable conditions.
- D. Submit shop drawings showing physical backpan layout of equipment in Control Panel.
- E. Submit communications block diagram including PLC, OI, motor controls, power supplies, switches, routers, radios, and any other connected components.
- F. Submit hardware Operations and Maintenance Manual per Electrical Specifications [Electrical General].

1.04 OPERATION AND MAINTENANCE INFORMATION

- A. Provide special tools, cabling and equipment necessary for normal operation, maintenance and calibration.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide PLC modules from a single family of products, using the same software and interchangeable I/O cards, that can be configured for a range of applications from small, uncomplicated sites to large, complex sites with a variety of equipment.
- B. Provide a PLC that will meet the following requirements:
 - 1. Size and provide a CPU and power supply to accommodate the CPU, I/O cards, communication devices, etc. as specified herein.
- C. Provide a PLC that can be expanded in the field by the addition of the following types of plug-in modules or cards and interface cables without rendering the originally furnished PLC components obsolete.
 - 1. Digital Inputs
 - 2. Digital Output
 - 3. Analog Input
 - 4. Analog Output with PID control
- D. Size the PLC enclosure such that local I/O modules and supporting hardware required to meet the ultimate point count, as specified herein, will fit into the space of a single enclosure.
- E. Provide PLC modules from a single family of products, using the same software and interchangeable I/O cards, that can be configured for a range of applications from small, uncomplicated sites to large, complex sites with a variety of equipment.
- F. Size the PLC enclosure such that local I/O modules and supporting hardware required to meet the ultimate point count, as specified herein, will fit into the space of a single enclosure.

2.02 MECHANICAL

- A. Provide modular PLC consisting CPU, power supply, communications, and I/O modules.
- B. Provide I/O modules with removable terminal strips so that I/O modules can be removed without disconnecting field wiring.

2.03 PLC COMPONENTS

- A. PLC Components - The following components shall be provided to complete the PLC(s). Only major components are listed. Multiples of some components are required- see Drawings
 - 1. VersaMax Micro 28 Controller ICU200DR005
 - a. 28 Point Micro PLC, 16 DI, 12 DO
 - b. 24 VDC input power
 - 2. Analog Input/Output Module IC200UJEX636
 - 3. 10/100 Mbit Ethernet Module IC200UEM001
 - 4. RS232 Module IC200USB001

2.04 ISOLATION/INTERFACE RELAYS

- A. Provide output isolation relays on all digital outputs that operate devices external to the control panel and on spare outputs or as otherwise shown in the Drawings. The relay coil connection shall be on one side of the relay base and form-C output contacts on the other.
- B. Relays shall be 6A SPDT, coil voltage as required, indicating, plug in style as manufactured by Allen Bradley 700-HLT1U1 or equal. Provide jumper bars for common buss connections, Allen Bradley 700-TBJ20G, or equal.

2.05 ETHERNET SWITCH

- A. The unmanaged Ethernet switch shall have minimum 8 ports. Ports shall be 10/100 Base-Tx with RJ-45, 8 pin female connectors. Switch shall be suitable for power from 10 - 30 VDC. Switch shall be N-Tron 108TX, Allen Bradley Stratix 2000, or equal.

2.06 OPERATOR INTERFACE (OI)

- 1. Maple Systems HMI5071L or equal.
- 2. Touch Screen
 - a. 7 inch screen size with 800 x 480 resolution, 16.7M colors.
 - b. TFT color touchscreen with LED backlight and 400nits brightness.
- 3. I/O Ports
 - a. RS232C, RS485 and 10/100 Base-T Ethernet communication options. Provide cables for connection to PLC.
- 4. Data storage
 - a. 128MB RAM, 128MB Flash memory.
- 5. Environmental conditions:
 - a. Operating Temperature: 32 to 122 degrees F
 - b. Storage Temperature: -4 to 140 degrees F
 - c. Humidity Rating: 10 to 90%, non-condensing
 - d. Rating: NEMA 4X (indoor only)

PART 3 EXECUTION

3.01 WORKMANSHIP

- A. All work in this Section shall conform to the codes and standards specified in Electrical Specifications [Electrical General, Workmanship].

3.02 INSTALLATION

- A. Fabrication
 - 1. Mount, wire and Ground PLC and OI per manufacturer's recommendations.
 - 2. Organize equipment on control panel backpan per Backpan Layout detail in Contract Drawings.
 - 3. Locate and install PLC(s) and OI(s) per Contract Drawings.
- B. Wiring
 - 1. Terminate status, control and analog wiring on terminal blocks.
 - 2. Label and wire PLC to terminal blocks per Electrical Specifications [Wire, Fuses & Terminal Block] and Example I/O Wiring Diagram in the Drawings.
 - 3. All spare I/O points shall be wired to terminal blocks.

4. Install communication cables to connect the PLC to external devices.
5. Bundle and tie down wires in a neat and orderly manner.
6. Terminate drain wire of shielded cables at backpan terminal block only.

3.03 FIELD ASSISTANCE

- A. Provide testing as specified in Electrical Specifications [Factory and Field Testing].

3.04 WARRANTY

- A. Provide warranty per Electrical Specifications [Electrical General, Warranty].
- B. Perform the following services during the warranty period:
 1. Repair or replace damaged modules returned for service within 24 hours.
 2. Determine and report the cause of failure of modules returned for service.
 3. Resolve design or implementation problems discovered.

3.05 FINAL ACCEPTANCE

- A. Final Acceptance per Electrical Specifications [Electrical General].

END OF SECTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The major components in the instrumentation scope of work are:
 - 1. Furnish, configure, test, commission, and warrant instrumentation as shown in the P&IDs, plans, and/or listed in specification section.
 - 2. Include necessary piping, valves, pressure reducers, mounting brackets or flanges, supports, and anchors to complete installation.
 - 3. Provide sunshades for instrumentation for all instruments that are exposed to direct sunlight.

- B. System Integrator selection of instrumentation shall be per manufacturer's recommendation for the application and per specifications. If a manufacturer's recommendation or installation instructions are inconsistent with the Contract installation details or specifications, then the Contractor shall submit an RFI describing the inconsistency. If the inconsistency is due to substitution from the first named equipment, then the responsibility of coordination and any additional cost shall be borne by the Contractor.

- C. Projects that come into contact with drinking water: (NSF-61 certification)
 - 1. Furnish NSF/ANSI 61 certified products that have undergone testing for any device, valve, instrument, or assembly that will come into contact with drinking water.
 - 2. The certification determines what contaminants may migrate or leach from the product into drinking water and confirms if they are below the maximum levels allowed to be considered safe.
 - 3. Flowmeters, pressure transmitters, and chemical analyzers are a few of the products that may fall into this category requirement.

- D. Provide all devices, valves, tubing, fittings, wiring, terminal blocks, calibration consumables, initial calibration equipment, accessories, sunshades and enclosures as specified herein and as shown on Contract Drawings.

- E. The Contractor shall furnish all tools, calibration equipment, calibration materials, specialized parts and incidentals necessary to integrate the instrument to the application.

- F. Contractor shall furnish labor for installation, verification, start-up, calibration, testing and commissioning. Contractor shall prove proper function of instrument prior project completion.

1.02 REFERENCES

- A. Electrical Specifications [Electrical General]
- B. Electrical Specifications [Factory and Field Testing]

1.03 SUBMITTALS AND DRAWINGS

- A. Submit shop documents and drawings for approval in accordance with this subsection and as specified in Electrical Specifications [Electrical General, Submittal Requirements].

- B. Submit Operating Instructions (O&M Manuals) for each instrumentation device prior to equipment installation.

1.04 OPERATING AND MAINTENANCE INFORMATION

- A. Provide operating instructions as specified in Electrical Specifications [Electrical General, Operating and Maintenance Instructions].

PART 2 PRODUCTS

2.01 QUALITY

- A. Electrical Specifications [Electrical General, Quality].
- B. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without requiring a manual reset.
- C. Signal transmission from remote or field electric and electronic devices shall be 4-20 mA, sourced by a 24 VDC supply internal to the instrument or from a 24 VDC power supply located within the panel that is to receive the signal. Nonstandard transmission methods such as impulse duration, pulse rate, and voltage regulated will not be permitted except where specifically noted.
- D. Transmitters or devices located in Class 1, Division 1 hazardous areas shall be rated for hazardous location installations per NEC and UL. Explosion proof enclosures and raceways or current/spark limiting devices located inside or outside of the classified area shall be furnished to comply with code requirements.
- E. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately converted to 4-20 mA signals for remote transmission.

2.02 INSTRUMENT IDENTIFICATION

- A. All major instrumentation and equipment items or systems specified in this Division and/or on the P&IDs are identified by tag numbers. Tag field equipment with assigned instrumentation tag number and functional description.
 - 1. Tags shall be 1/2" stainless steel DYMO impressed tape with 3/16"(minimum) height characters.
 - 2. Metal tape embosser shall feature a built in hole punching device and scissor cutoff tool.
- B. Attach tags to equipment with a 4" long, 20-gage stainless steel wire leash for small devices, or two stainless steel screws for larger instruments; however, such permanent attachment shall not be on an ordinarily replaceable part or in an area that will be subject to unintended overuse fatigue. Make the tag plainly visible.

2.03 LEVEL COMPONENTS

- A. Float Switch
 - 1. Tilting float level switches shall be a mercury free float switch, whose specified weight is less than that of the process liquid displaced, to actuate switches as the level changes. The non-mercury snap action switch is actuated by a steel ball

rolling back and forth within a switching tube in plastic float housing. The SPDT switch shall be rated 7A at 120 VAC shall be integrally mounted in the float and connected to a control box by a nitrile PVC jacketed waterproof electric cable with three finely stranded No.18 conductors. The weight shall be integrally mounted so that no metals shall contact the process liquid. Tilting type level switch shall be Anchor Scientific Eco-Float Model GSI, or equal.

2.04 PRESSURE COMPONENTS

- A. Gauge, Absolute, or Differential Pressure Transmitter:
1. The pressure indicating transmitter shall be a loop powered, two wire, 4-20 mA signal transmitting device with signal derived from the applied sensor pressure. Transmitter shall be capable of driving 0 to 500 ohm loads with 24 VDC supply.
 2. The transmitter shall have the following features:
 - a. Programmable 4-digit Liquid Crystal Display (LCD) process indicator.
 - b. HART programming with programming selections for square root extraction, output calibration, and adjustable dampening 0.0 to 36.0 seconds, minimum.
 - c. Integral microprocessor based circuitry with RFI filtering and shielding.
 - d. The transmitter shall have accuracy of +/- 0.1% of span over a range of minimum 10 to 1 turndown. Elevated zero setting capable of 0-30% upper calibration limit.
 - e. Operating temperature range shall be -40 to 185°F (minimum). Process wetted materials shall be compatible with fluid being measured with minimum hastalloy or ceramic diaphragm and 316 stainless steel wetted parts.
 - f. Process connection shall be as follows:
 - 1) Low solids content - 1/2" MNPT with calibration valve.
 - 2) High solids content - 1-1/2" or 2" flange with flushing ring and valve.
 - 3) And as required per installation detail.
 - g. The transmitter shall be scaled as shown in the instrument schedule.
 3. Provide mounting bracket per mounting requirements shown in Contract drawings.
 4. The gauge pressure transmitter shall be Endress and Hauser Cerabar M PMC 71, Rosemount Smart 3051, or equal.
- B. Calibration Valve:
1. Calibration valve for use with gauge transmitters shall have the following features:
 - a. Stainless steel body with integral blocking valve and calibration valve and port.
 - b. Calibration port shall be 1/4" FNPT with 1/4" MNPT x 1/2" FNPT adapter.
 - c. Valve shall have a non-rotating stem tip and a fully backseated bonnet.
 - d. Process and transmitter connections shall be 1/2" MNPT. Include 1/2" stainless steel close nipple as required.
 2. Calibration valve shall be Hex HB59, Anderson Greenwood, or equal.
- C. Pressure Switch:
1. Each pressure switch shall be SPDT rated minimum of 15 amps @ 120VAC. Pressure switch shall consist of a pressure sensing mechanism and the switch itself enclosed in a NEMA rated housing. Pressure switch shall be bourdon tube type or diaphragm type with stainless steel wetted parts and mechanical snap action switch. Switch shall have two setpoint adjustments (trip & reset setpoints),

narrow deadband with setpoint indicator calibrated in engineering units and viewable from outside switch cover. Pressure switch shall be UL listed. The pressure switch shall be Dwyer Mercoid DAW series; Square "D" 9016, ASCO or equal.

D. Pressure Gauge:

1. The pressure gauge shall be 1% accurate with C-type bourdon tube. The bourdon tube, socket and connection tube of the gauge shall be 316 stainless steel. The case and bezel ring shall be constructed of type 304 stainless steel. The dial shall be 4" in diameter with a black pointer and a white gauge face with black print. The gauge shall be filled with liquid glycerin. A bottom mount process connection shall include a snubber as a separate component. The process connection shall be 1/2" stainless steel. The pressure gauge shall be Ametek gauge model 1550, Ashcroft 1009, or equal.

2.05 FLOW COMPONENTS

A. Magnetic Flow Meter:

1. The magnetic flow meter shall consist of a flow tube FE and a converter FIT, complete with interconnecting cables.
2. The magnetic flow meter shall be of the low frequency electromagnetic induction type and shall produce a DC pulse signal directly proportional and linear to the flow rate, with the duration not less than 100 milliseconds. Complete zero stability shall be an inherent characteristic of the metering system. Meters requiring field zero adjustment will not be acceptable. The meter accuracy shall not be affected by changes in fluid pressure, temperature, viscosity, or conductivity.
3. Accuracy
 - a. The maximum error of the complete metering system including flow element and flow indicating transmitter shall be 0.30% of actual flowrate (in specified units) and readout over the range of full scale velocity settings from 1 to 30 feet per second. Variations in temperature, voltage, and frequency within the ranges listed herein shall not affect the overall measuring accuracy.
 - b. The flow meter shall not require more than three diameters of straight pipe length from the center of the meter to upstream or downstream obstructions to obtain specified accuracies.
4. Flow Element (FE)
 - a. The flow element shall be based on a pipe spool with ANSI class 150 flange connections or be flangeless construction as required by mechanical drawings. Class 300 flanges shall be provided where shown or when the pressure and temperature of the process fluid exceeds the rating of a 150 lb flange. The flow element size shall be as shown in the mechanical drawings and listed in the Instrumentation Schedule. Flange type and bolt pattern shall be coordinated with the mechanical Contractor prior to submittal.
 - b. The flow element shall have Hastalloy C4 coil and grounding electrodes.
 - c. Stainless steel grounding rings shall be provided at both ends of the flow element for all flowmeter applications. Grounding rings shall be manufactured from stainless steel, 2 mm thickness with grounding tab for electrical wire connection, and fit within the flange bolt circle. Grounding ring shall be self centering within pipe.

- d. The flow element internal liner material shall be polyurethane unless recommended otherwise by the manufacturer for the application and approved.
- e. Nema rating as defined in the Instrumentation Schedule.
- 5. Flow Indicating Transmitter (FIT)
 - a. The electronic transmitter shall be provided in a NEMA rated enclosure per the Instrumentation Schedule.
 - b. The transmitter shall be interchangeable with all sizes of flow elements and shall be field replaceable (without replacing flow element) in the event of transmitter failure.
 - c. The transmitter shall be microprocessor controlled, utilizing digital signal processing with automatic zero correction to provide a linear 4 20 mA signal proportional to flow rate.
 - d. The transmitter shall incorporate a high impedance amplifier of 100,000 Megohms or greater, eliminating the need for electrode cleaning systems.
 - e. The transmitter shall contain a self test mode to allow the operator to manually simulate the output 4 20 mA signal to any value between 0% and 100% to check out any driven devices in the loop.
 - f. Rate indicator and totalizer: An alphanumeric LCD backlit display shall be provided to continuously display the flowrate and totalizer with units and all programming functions.
 - g. All programming configuration of the Flowmeter shall be completed through the transmitter's pushbutton interface. A communication device shall not be necessary to configure the flow transmitter.
 - h. PC based software shall be available and included for configuration and troubleshooting. Connection to flowmeter shall be via computer USB port and include interface cables as required.
 - i. The transmitter shall be designed for operation from a power source of 120 volts AC, with a power consumption of less than 20 watts. The flow element shall be powered from the transmitter.
 - j. The transmitter shall operate continuously without fault in an ambient temperature range from 14 to 140 °F. The flowmeter shall be suitable for operation in direct sunlight without the use of a sunshade. If a sunshade becomes required after installation for any operational reason, one shall be furnished and installed free of charge.
 - k. The following configurable parameters shall be provided at a minimum:
 - 1) Field adjustable flow signal dampening.
 - 2) Low flow cutoff (forces zero flow signal) between 0.0-5.0% of full scale rate.
 - 3) Empty pipe detection (forces zero flow signal) if the pipe is not full.
 - 4) Selection for forward/reverse/both flow directions.
- 6. Flow Indicating Transmitter (FIT) I/O Interface
 - a. Flow Signal: 4-20 mA signal proportional to the flow. The signal shall be field configurable for the flow calibration specified and others within the flow tube accuracy range. The flow signal shall be capable of measurement for forward and reverse flows combined by offsetting zero to mid scale (12 mA).
- 7. If the flow indicating transmitter (FIT) is shown in the Contract drawings to be mounted remotely from the flow element (FE), the manufacturer shall provide all cabling between flow element and flow indicating transmitter.
- 8. All mounting hardware and/or devices necessary to complete the installation shall be provided by the manufacturer at no additional cost to the Owner.

9. The meter shall be hydraulically calibrated at a facility located in the United States and the calibration shall be traceable to the National Bureau of Standards. A certified copy of the calibration test results shall be submitted to the Owner prior to shipment of the meter.
10. The magnetic flowmeter shall be Seametrics, iMag 4700p, Endress and Hauser Promag 400L or equal.

2.06 ANALYTICAL ELEMENTS

- A. Water Quality Analyzer Panel:
 1. The Panel shall be a single panel with instruments mounted, wired and plumbed prior to shipment to project site.
 2. The sensors shall all be digital type. Each measurement shall include at least one electrode sensor, and connect to the controller/transmitter unit. Include flow thru cells for each sensor. The scaled range shall be as shown in the instrumentation schedule, located at the end of this section.
 3. The panel shall include the following on-line analytical sensors:
 - a. pH
 - b. Chlorine residual
 4. The sample and drain system shall accommodate flows of 1000 to 1500 mL/min. The sample system shall consist of a single sample manifold to supply all instruments. A single drain manifold shall be provided to collect discharge from all analytical instruments.
 5. All water quality analyzer panel shall be custom fabricated with Hach components, no equal.
 6. The panel shall include the following instruments:
 - a. Analyzer, Hach SC1000 controller or multiple SC200 controllers, with quantity of inputs and outputs as needed. 120 vac powered.
 - b. pH probe, DPD series
 - c. Free chlorine residual CLF10sc series.

2.07 EVENT, STATE OR POSITION DEVICES

- A. Position Switch:
 1. Hatch or Vault – hatch or vault intrusion switch be a magnetically actuated switch shall be 304 stainless steel and NEMA 4X and include a pre-wired factory sealed 2 foot cable for wet applications. The switch shall include the permanent magnet and the reed switch blocks with 0.5 inch sensing range. Switch shall have normally open and normally closed contacts rated for 0.2A at 120 VAC each. When attaching to a ferrous metal surface, space sensor components away from metal by minimum ¼” using plastic spacer in order to maintain magnetic gap. Switch shall be Sentrol Model 191-6Z-12K or equal.
- B. Smoke Detector:
 1. General
 - a. The smoke detector shall detect smoke produced by fire and signal an alarm system. The detector shall be housed in a flame retardant plastic housing and shall be unaffected by vibration. Detector shall be sealed against dirt, insects and back pressure
 - b. Detector shall utilize photoelectronic sensor technology.
 - c. The detector/base shall be 120V, four-wire operation with built-in Form A and Form C dry contacts. Form A contact shall be rated for 2.0A at 30VAC/DC. Form C contact shall be rated for 2.0A at 30VAC/DC and 1.0A at 120VAC.

- d. The detector shall have an operating temperature 32 to 120°F and an operating humidity of 10 to 93% relative humidity.
 - e. The detector shall have built-in test switch (magnetic proximity actuation) and 360 degree view angle of built-in alarm LEDs.
 - f. The detector shall be approved by UL and Factory Mutual and meet requirements of NFPA 72.
2. The fire alarm smoke detector shall be photoelectric type. The smoke detector shall be System Sensor 100 Series model 2151 with B114LP base, Gentex 8000 Series with 120VAC base, or equal.

2.08 INSTRUMENTATION SCHEDULE

- A. The Instrumentation Schedule spreadsheet (located at the end of this section) is intended to be a summary of instrumentation equipment required for this project. Not all instrumentation details are shown on the schedule. Some requirements may be shown in the Instrumentation Schedule such as enclosure rating and instrument span that are not described in the specifications. Both are required for a complete specification.
- B. If an instrument is shown in the P&IDs or on the site plan, then the device shall be provided whether or not it is shown on the Instrumentation Schedule.

PART 3 EXECUTION

3.01 WORKMANSHIP

- A. Instrumentation work shall conform to workmanship standards specified in Electrical Specifications [Electrical General, Workmanship].
- B. The Contractor shall employ personnel who are skilled and experienced in the installation and connection of equipment defined in this section. Contractor qualifications are specified in Electrical Specifications [Electrical General].
- C. Verify that all equipment and materials fit properly.
- D. All instrumentation configuration, programming and calibration shall be completed prior to the start of field tests.
- E. Equipment without approved submittals shall not be installed.
- F. All equipment shall be properly stored indoors while awaiting installation. Protect installed equipment from construction debris or mishaps. The Contractor will replace any equipment that is not in new condition at the time of installation and/or start-up.
- G. Perform work to remedy non-compliant installations after inspection.

3.02 INSTALLATION

- A. Install and supply all products necessary to provide an operational instrumentation system. This shall include the following:
 - 1. Contract Drawings are intended to show the basic functional requirements of the instrumentation system. Insufficient detail does not relieve the Contractor from the responsibility to provide a complete and functioning system. If additional

detail or clarification is required, the Contractor shall request such information prior to installation.

2. Provide relays, signal converters, isolators, boosters, power conditioners, circuit cards, and other miscellaneous devices as required for the compatible and functional interface.
3. Provide analog loop isolators where required to eliminate "ground loops."
4. The instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions and located as shown on the Drawings or as approved. When manufacturer's installation literature specifies a particular location or orientation in a process line due to measurement accuracy considerations, the installation shall be in conformance with the manufacturer's instructions.

B. Instrument installation methods.

1. Install instruments at the location shown on the Plans or approved. Instruments enclosures shall be NEMA rated for the installed location.
2. Install level and plumb.
3. All instruments shall be provided with floor stands or wall brackets as shown in installation details or as required for functional installation.
4. Mounting stands shall be custom manufactured of aluminum channel with base plate unless otherwise noted in installation detail.
5. Mounting channels (unistrut), and spacers shall be galvanized steel above ground outdoors and stainless steel below ground (wetwell), unless otherwise noted in installation details.
6. All screws, bolts and anchors shall be stainless steel.

C. Wiring and raceway installation methods:

1. Terminal blocks shall be provided at all instrument cable junctions and all wires shall be identified at such junctions.
2. Instrumentation wiring shall be run without splices between instruments, terminal boxes, or panels.

D. Wiring, grounding, and shielding: The following practices shall be observed unless modified by manufacturer's standards.

1. Each electronic equipment chassis shall be grounded to power ground.
2. Shielded twisted pair, shielded triad, or manufacturer supplied cables only shall be used for analog signals and communications signals.
3. Drain wire of shielded cables used for analog inputs to the PLC shall be connected at the PLC unit only. Shield shall be isolated from ground at all other termination points including transmitters.
4. Drain wire of shielded cables used for analog outputs from the PLC shall be connected at signal receiving device only. Shield shall be isolated from ground at all other termination points.
5. If electrical interference noise is imposed on DC status and alarm signals, then they shall be re-routed or wire changed to shielded twisted pair cables.
6. Each shield drain wire which is not connected to ground shall be cut off covered with a heat shrink insulating boot at cable jacket end. Shields shall be connected together at each transition from one cable to another for an effectively continuous shield circuit.

3.03 SUPPLIER SERVICES

- A. The Contractor shall be responsible for each supplier of equipment to provide the following minimum services for each type of instrument supplied. Each supplier shall

provide a qualified instrumentation field technician to perform services listed herein. Contractor shall supply all calibration materials necessary to commission unit and shall not use any consumable materials that are intended to be furnished for the first period of use.

1. Advise and instruct Contractor on proper installation requirements.
2. Inspect, calibrate, test, and place equipment in operation. Calibrate instruments to values as shown in the instrument index or as noted herein. If instrument spans are required to change (within instrument range) during startup for process reasons, the Contractor shall change them as directed by the Engineer.
3. Programmable devices shall be programmed and tested prior to startup. Programming shall be adjusted or changed as directed by the Engineer at any time prior to final acceptance.
4. Perform testing in the presence of Engineer.
5. Visit the project site as often as required and spend as much time as necessary to ensure accurate and operational instrumentation.
6. Provide training as specified in FIELD ASSISTANCE.

- B. The Contractor shall coordinate with each supplier of instrumentation to confirm that primary elements are provided in a timely manner, meeting critical path scheduling. The Contractor shall coordinate process connection size, equipment size, and material type when applicable and oversee the installation, calibration, and acceptance testing.

3.04 FIELD ASSISTANCE

- A. The instrument supplier shall provide a minimum of one (1) hour of field training to instruct Owner's personnel in the use, operation, calibration, programming, and maintenance on each type of "field" instrument.

3.05 SPARE PARTS

- A. Provide spare parts as described in each products section herein and specified in Electrical Specifications [Electrical General, Spare Parts].
- B. Contractor shall supply all calibration materials necessary to commission unit and shall not use any consumable materials that are intended to be handed over to the Owner as defined in the instrument specifications.

3.06 WARRANTY

- A. Provide warranty as specified in Electrical Specifications [Electrical General, Warranty].

3.07 FINAL ACCEPTANCE

- A. Final Acceptance per Electrical Specifications [Electrical General].

END OF SECTION

16940 INSTRUMENTATION INDEX

DWG # P&ID	Tag No.	DESCRIPTION	Type	Specification Section	Min. NEMA Rating	Size	SP/ Range	Units	DWG. DET. Reference	Notes
I-2	LIT 051	Level Indicating Transmitter	Gauge	16940-2.04 A	4X	-	0-40	FT	LTD	
I-2	LSH 052	Level Switch	Float	16940-2.03 A	-	-	-	-	THD	15 Ft. Cable
I-2	LSL 052	Level Switch	Float	16940-2.03 A	-	-	-	-	THD	30 Ft. Cable
I-2	PIT 061	Level Indicating Transmitter	Gauge	16940-2.04 A	4X	-	0-200	PSI	PTD	
I-2	FIT 071	Flow Indicating Transmitter	Magnetic	16940-2.05 A	4X	12"	0-2000	GPM	FMD/FLG	
I-2	AIT 081	Analyzer Transmitter	CL2/pH	16940-2.06 A	4X	-	-	-	Wall Mount	
I-2	ZS 091	Hatch Switch	magnetic	16940-2.07 A	1	-	-	-	Hatch	
I-2	SS 096	Smoke Detector	Photo	16940-2.08 B	1	-	-	-	Ceiling Mount	
I-2	PSH 161	Pressure Switch	Diaphragm	16940-2.04 C	4	-	20-200	PSI	PTD	
I-2	PI 161	Pressure Gauge	Gauge	16940-2.04 D	4X	-	0-200	PSI		
I-2	PSH 261	Pressure Switch	Diaphragm	16940-2.04 C	4	-	20-200	PSI	PTD	
I-2	PI 261	Pressure Gauge	Gauge	16940-2.04 D	4X	-	0-200	PSI		