



CITY OF MERCER ISLAND **BOOSTER CHLORINATION SYSTEM**

Bid No. 21-28

JUNE 2021

VOLUME 1 OF 2

Specifications and Contract Documents

Prepared for

City of Mercer Island

Rona Lin, PE, Utilities Engineer

9601 SE 36th St

Mercer Island, WA 98040

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FOREWORD

THE ITEMS WHICH MAKE UP THE CONTRACT DOCUMENTS ARE AS FOLLOWS:

DIVISION 0

NOTICES, BIDDING REQUIREMENTS, AND AGREEMENT FORMS

Notices, Bidding Requirements, and Agreement Forms have been copied and bound together with the remainder of the Contract Documents to facilitate the bidder's submittal of this proposal and other required documents.

GENERAL TERMS AND CONDITIONS

SUPPLEMENTAL CONDITIONS

TECHNICAL SPECIFICATIONS

APPENDICES

- A. Prevailing Minimum Hourly Wage Rates
- B. Sample K Plans

PLANS (Bound Separately)

The Project Manual for the Booster Chlorination System Project for the City of Mercer Island has been prepared under the direction of the following Registered Professional Engineer.

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PLANS (Bound Separately)

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NOTICES

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Advertisement for Bids City of Mercer Island

Project Title: Booster Chlorination System Project
Bid Number: 21-28
Engineers Estimated Cost (range): \$2,300,000 - \$2,500,000

Sealed bids will be received, not sent, electronically by the City until **10:00 AM on July 2, 2021**. **Due to the COVID-19 Pandemic and the temporary closure of the City Hall building, bidders** shall submit their bids in PDF format via electronic transmission to the Public Works email address at: **publicworks@mercergov.org**

IMPORTANT NOTES:

- 1) A mandatory pre-bid walk through will be held at Reservoir Pump Station at 10:00AM on Tuesday June 22, 2021. Bids submitted by bidders without attending this walk-through will NOT be accepted.
- 2) There will be no public bid opening for this project. Bid results will be posted on City's web page at: <https://www.mercerisland.gov/rfps>
- 3) Due to the restrictions imposed by State government in response to the global pandemic of Coronavirus, the start date and construction schedule may be affected. Bidders are advised to include this consideration when submitting their bids.

Work to be performed under this contract includes the construction of a new booster chlorination system at the City's reservoir site and perform associated water system modifications. Work generally consists of two (2) Schedules outlined in the bid packet.

Detail descriptions of work items are summarized in Section 01_11_00 of the technical specifications.

A single contract will be awarded to the responsible bidder submitting the lowest bid for Schedule A, taking into account the Bidder's Qualifications and other bidding requirements.

The City of Mercer Island reserves the rights to reject any or all bids to waive minor irregularities, and/or to modify the size of the project. The Additive Alternate - Schedule B will be awarded to the lowest bidder of Schedule A, if the total bid price is within budgeted funds."

Plans, specifications, addenda, and bidders list are available on-line through Builders Exchange of Washington, Inc. at <http://www.bxwa.com>. Click on "Posted Projects", "Public Works", "City of Mercer Island", "Projects Bidding". Builders Exchange manages the official bidders list. Bidders are encouraged to register in order to receive automatic email notification of future addenda and to be placed on the official bidders list.

Plans and specifications are also available at the City of Mercer Island website <https://www.mercerisland.gov/rfps>. Addenda may not be available or updated on this website.

A bid deposit in the amount of five percent (5%) of the bid total price must accompany each bid.

Bidder questions are to be submitted to Rona Lin, Utilities Engineer, by email only at rona.lin@mercergov.org.

The City of Mercer Island, in accordance with Title VI of the Civil Rights Act of 1964, 78 Stat. 252, 42 U.S.C. 2000d to 2000d-4 and Title 49, Code of Federal Regulations, Department of Transportation, Subtitle A, Office of the Secretary, Part 21, Nondiscrimination in Federally-assisted programs of the Department of Transportation issued pursuant to such Act, hereby notifies all bidders that it will affirmatively ensure that in any contract entered into pursuant to this advertisement, disadvantaged business enterprises as defined at 49 CFR Part 23 will be afforded full opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, national origin, or sex in consideration for an award.

Deborah Estrada, MMC, City Clerk

Published: Seattle Daily Journal of Commerce 6/14/2021 and 6/21/2021

City of Mercer Island Instructions to Bidders

1. ELIGIBILITY TO BID:

It is the intent of the City to award a contract to the low responsible bidder. Before award, the bidder must meet the following bidder responsibility criteria to be considered a responsible bidder. To be eligible to bid, each Bidder must:

- A. At the time of bid submittal, have a current certificate of registration as a contractor in compliance with chapter 18.27 RCW; and
- B. Have a current Washington Unified Business Identifier (UBI) number; and
- C. If applicable:
 - i. Have Industrial Insurance (workers' compensation) coverage for the bidder's employees working in Washington, as required in Title 51 RCW; and
 - ii. Have a Washington Employment Security Department number, as required in Title 50 RCW; and
 - iii. Have a Washington Department of Revenue state excise tax registration number, as required in Title 82 RCW; and
- D. Not be disqualified from bidding on any public works contract under RCW 39.06.010 or 39.12.065(3); and
- E. Within the three-year period immediately preceding the date of the bid solicitation, not have been determined by a final and binding citation and notice of assessment issued by the department of labor and industries or through a civil judgment entered by a court of limited or general jurisdiction to have willfully violated, as defined in RCW 49.48.082, any provision of chapter 49.46, 49.48 or 49.52 RCW.

A contract shall only be awarded to a Bidder that demonstrates to the City's satisfaction that the Bidder is qualified to perform the Work and is, therefore, a responsible bidder.

2. SUBCONTRACTOR RESPONSIBILITY CRITERIA:

The Bidder must verify responsibility criteria for each first-tier subcontractor, and each subcontractor of any tier that hires other subcontractors must verify responsibility criteria for each of its subcontractors. Upon request of the City the Bidder shall promptly provide documentation to the City demonstrating that the subcontractor(s) meets the subcontractor responsibility criteria below. The requirements of this section apply to all subcontractors regardless of tier.

At the time of subcontract execution, the Bidder shall verify that each of its first-tier subcontractors meets the following bidder responsibility criteria:

- A. Have a current certificate of registration in compliance with chapter 18.27 RCW; and
- B. Have a current Washington Unified Business Identifier (UBI) number; and

- C. If applicable:
 - i. Have Industrial Insurance (workers' compensation) coverage for the subcontractor's employees working in Washington, as required in Title 51 RCW; and
 - ii. Have a Washington Employment Security Department number, as required in Title 50 RCW; and
 - iii. Have a Washington Department of Revenue state excise tax registration number as required in Title 82 RCW; and
 - iv. Have an electrical contractor license, if required by Chapter 19.28 RCW; and
 - v. Have an elevator contractor license, if required by Chapter 70.87 RCW; and
- D. Not be disqualified from bidding on any public works contract under RCW 39.06.010 or 39.12.065 (3); and

3. EXAMINATION OF PLANS, SPECIFICATIONS AND SITE:

Each bidder is instructed to examine the Plans, Specifications, Addenda, the site of the proposed improvements, and conduct any other examination and investigation which the bidder may desire to make as to the accuracy of the nature of the work and the difficulties to be encountered. The Bidder shall be responsible for all costs associated with these additional examinations including all restoration work and damages which may be a result of such investigation. Bidders shall consider Federal, State, and local laws and regulations that may affect cost, progress, or performance of the work.

4. ADDITIONAL INFORMATION:

All questions about the meaning or intent of the Contract Documents are to be directed to Rona Lin, in writing by email at rona.lin@mercerisland.gov

Interpretations or clarifications considered necessary by the City in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by the Engineer or City as having received the Contract Documents. Questions received less than ten (10) days prior to the date for opening of Bids may not be answered. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

5. WAGES:

This Contract is subject to Chapters 39.12 and 49.28 RCW, amendments thereto and regulations issued thereunder, relating to prevailing wages, benefits and other requirements. Bidders shall examine and be familiar with such requirements. No claim for additional compensation will be allowed which is based upon a lack of knowledge or a misunderstanding of any such requirements by the Bidder or a failure to include in Bidder's price adequate increases in such wages during the performance of this Contract. A copy of the most recent prevailing wage schedule is in the Appendix of the specifications. Current prevailing wage rates for King County can be obtained from the Washington State Department of Labor and Industries at www.lni.wa.gov/TradesLicensing/PrevWage/.

6. PROGRESS AND COMPLETION:

Time is of the essence for this Project. Progress and completion of the Work shall comply with all requirements herein, and intermediate and final completion dates as may be set forth in the specifications. The submission of

a bid constitutes the Bidder's acknowledgement that such progress and completion requirements have been taken into account in formulating a price for this Work.

7. PREVENTION OF ENVIRONMENTAL POLLUTION AND PRESERVATION OF PUBLIC NATURAL RESOURCES:

If awarded the Contract, the Bidder shall fully comply with all such environmental protection laws, ordinances and regulations dealing with prevention and environmental pollution and the preservation of public natural resources that may be applicable to this Project. The cost of such compliance shall be included in the bid prices.

8. BID FORM:

The Bid Form is included in the Contract Documents. The Bid Form must be completed in ink. Bids that contain omissions, erasures or irregularities of any kind may be rejected. Any qualification, addition, limitation or provision attached to or contained in a bid may render the bid non-responsive and not eligible for award. No oral, facsimile, telegraphic or telephonic bids or modifications will be considered.

All bids shall be signed by the Bidder, or the Bidder's authorized representative. If the bid is made:

- A. By an individual, the Bidder's name, signature, and address must be shown;
- B. By a partnership or joint venture, it shall contain the names of each partner, the mailing address of the partnership or joint venture and shall be signed in the firm name, followed by the signature of the person signing, indicating that person's position in the partnership or joint venture;
- C. By a corporation or limited liability company ("LLC"), the name of the state under the laws of which the corporation or LLC is chartered, the name and post office address of the corporation or LLC and the title of the person who signs on behalf of the corporation or LLC must be shown.

Upon the City's request, the Bidder shall provide copies of the articles of incorporation, bylaws, resolutions of board of directors, partnership papers, joint venture agreements, and any other documents evidencing the legal status of the Bidder and the authority of the Bidder's officer or representative who signed the bid on behalf of the Bidder.

The City is not responsible for any cost incurred in responding to this Call for Bids.

9. ACKNOWLEDGEMENT OF ADDENDA:

Each Bidder shall include on the Bid Form specific acknowledgment of receipt of each Addendum issued by the City during the bidding period. If the Bidder does not specifically acknowledge each addendum, the City may reject the bid as non-responsive unless the City determines from delivery records or from inclusion of information in the bid of information contained in the addenda that the Bidder received constructive notice of the addenda.

10. BID SECURITY:

The Bid shall be accompanied by a bid deposit in the amount equal to at least 5% of the Total Bid Price. The bid deposit shall be in one of the following formats and made payable to the City:

- A. A bid guaranty bond, in accordance with and using a form acceptable to the City which contains provisions substantially similar to those in the bid bond form included with the Contract Documents, duly completed by a guaranty company authorized to carry on business in the state of Washington; or
- B. A postal money order, a certified check, or cashier's check drawn upon a banking institution with a branch office in the state of Washington.

The surety signing the bid guaranty bond shall be registered with the Washington State Insurance Commissioner, and the surety's name shall appear in the current Authorized Insurance Company List in the State of Washington published by the Office of the Insurance Commissioner. A Power of Attorney must accompany the bid guaranty bond and must appoint the surety's true and lawful attorney-in-fact to make, execute, seal and deliver the bid guarantee bond. Failure to submit the required bid security with the Bid shall render the bid non-responsive and the Bid shall be rejected.

11. NON-COLLUSION:

Each bid shall be accompanied by a signed Non-Collusion Declaration in accordance with, and using the form provided by the City. Failure to submit a signed Declaration with the Bid shall render the bid non-responsive and the Bid shall be rejected.

More than one Bid from an individual, firm, partnership, corporation, or association under the same or different names will not be considered. If the City believes that any Bidder is interested in more than one Bid for the work contemplated, all Bids in which such Bidder is interested will be rejected. If the City believes that collusion exists among the Bidders, all Bids will be rejected.

12. DELIVERY OF BID:

Each Bid shall be submitted in a sealed envelope to the City of Mercer Island at the CPD Permit Counter, 9611 SE 36th Street, Mercer Island, WA, 98040. The City will not consider bids received after the time fixed for opening bids in the Advertisement for Bids.

The submission of a Bid will constitute an incontrovertible representation by the Bidder that the Bidder has complied with every requirement of these instructions, that without exception the Bid is premised upon performing the work required by the Contract Documents and such means, methods, techniques, sequences, or procedures of construction as may be indicated in or required by the Contract Documents, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance of the work.

13. MODIFICATION OF BID:

A modification of a Bid will be considered only if the modification is received prior to the time announced for the opening of Bids. All modifications shall be made in writing executed and submitted in the same form and manner as the original Bid.

14. RETURN OF BID SECURITY:

After the bid prices have been compared, the City may return the bid security if, in the City's judgment, the Bidder would not be considered for award. All other Proposal Guarantees will be held until the Contract and the Performance Bond of the successful bidder have been executed.

15. EVALUATION OF BIDS AND BID ERRORS:

After opening the Bids, the City will check them for correctness of extensions of the prices per unit and the total price. If a discrepancy exists between the price per unit and the extended amount of any bid item, the price per unit will control. The total of extensions, corrected where necessary, will be used by the City for award purposes.

Irregular Bids:

- A. A Bid will be considered irregular and will be rejected if:
 - i. The authorized Bid Form furnished by the City is not used or is materially altered;
 - ii. The completed Bid Form contains any unauthorized additions, deletions, alternate bids, or conditions;
 - iii. The bidder adds provisions reserving the right to reject or accept the Award, or enter into the Contract;
 - iv. A price per unit cannot be determined from the Bid Form;
 - v. The Bid Form is not properly executed;
 - vi. An executed non-collusion certificate is not provided; or
 - vii. Proper bid security does not accompany the Bid.

- B. A Bid may be considered irregular and may be rejected if:
 - i. The Bid Form does not include a unit price for every Bid item;
 - ii. Any of the unit prices are excessively unbalanced (either above or below the amount of a reasonable Bid) to the potential detriment of the City;
 - iii. Receipt of Addenda is not acknowledged;
 - iv. A member of a joint venture or partnership and the joint venture or partnership submit Bid Forms for the same project (in such an instance, both Bids may be rejected); or
 - v. If Bid Form entries are not made in ink.

Bids will be evaluated by the City to determine which bid is the apparent lowest, responsive bid.

Bid results will be posted on the City's website at www.mercergov.org.

The City, in its sole discretion, reserves the right to waive minor bid errors, informalities, and immaterial irregularities when it is in the City's best interest to do so.

16. EVALUATION OF BIDDER RESPONSIBILITY:

A Contract shall only be awarded to a Bidder that demonstrates to the City's satisfaction that the Bidder is qualified to perform the Work and is, therefore, a responsible bidder.

- A. Bidder Responsibility Criteria. To be determined responsible, the Bidder must, in addition to satisfying the bidder responsibility criteria listed in Section 1. ELIGIBILITY TO BID above:
 - i. Have adequate financial resources to perform the contract, or the ability to obtain them;
 - ii. Have a satisfactory performance record;

- iii. Have a satisfactory record of integrity and business ethics;
 - iv. Have the necessary production, construction, and technical equipment and facilities or the ability to obtain them;
 - v. Be otherwise qualified and eligible to receive an award under applicable laws and regulations;
 - vi. Be in compliance with training requirements in RCW 39.04.350(1)(f); and
 - vii. Provide a statement in accordance with RCW 9A.72.085 verifying compliance with responsible bidder criteria requirement of RCW 39.04.350(1)(g).
- B. Reference Checking. To assist the City in the review of the Bidder's qualifications, the Bidder shall, within five (5) days of being requested to do so by the City, provide the following information:
- i. Past Experience in Similar Projects. Provide a list of all construction contracts (whether completed or in progress) entered into or performed by the Bidder within the past five (5) years for projects similar in scope, time and complexity to the work called for under this Contract. Provide the names of the contracts, the contract price, and the names and phone numbers of the owners.
 - ii. References. Provide a list of five (5) references. References will be asked to rate performance on the following items: overall project performance; acceptable experience and technical knowledge; effective coordination of subcontractors; ability to coordinate and work with utility companies and governmental entities; responsiveness to owner requests; attention to safety; quality and timeliness of submittals, change order proposals, project schedule, schedule updates and other applicable paperwork.

If the Bidder is a joint venture, the Bidder shall submit information for the joint venture if the members have worked together in the past and also information about each member of the joint venture. The Joint Venture Agreement shall be included in the submission.

If the Bidder fails to supply information requested concerning responsibility within the time and the manner specified, the City may base its determination of responsibility upon any available information related to the responsibility criteria or may find the Bidder is not responsible.

The City reserves the right to inspect records, reports and other information which may be maintained by or for the Bidder to the extent necessary, as determined by the City to verify, clarify or otherwise consider the information provided by the Bidder.

17. DETERMINATION OF NON-RESPONSIBILITY:

If the City determines a Bidder to be not responsible, the City will provide, in writing, the reasons for the determination. The Bidder may appeal the determination within ten (10) days of its receipt of the City's determination of non-responsibility by presenting additional information to the City. The City shall consider the additional information before issuing its final determination. If the City's final determination affirms that the Bidder is not responsible, the City shall not execute a contract with any other bidder until two (2) business days after the Bidder determined to be not responsible has received the final determination.

18. CONTRACT AWARD:

If a Contract is awarded, the City will award the contract to the responsible bidder that submits the lowest total responsive bid for the schedule(s) selected by City after bid opening and prior to award.

If the Contract is to be awarded, City will give the successful Bidder a Notice of Award within sixty (60) days after the day of the Bid opening. No other act of the City or others will constitute acceptance of a Bid.

The City reserves the right to request bidders to extend the effective period of their bids.

19. REJECTION OF ALL BIDS:

The City reserves the right to reject any or all Bids at any time up to actual execution of the Public Works Contract, even if there has been an award of the Contract.

Any or all Bids will be rejected if the City has reason to believe that collusion exists among the Bidders.

20. EXECUTION OF PUBLIC WORKS CONTRACT:

The Bidder to whom award is made shall execute a written Public Works Contract with the City on the form provided, shall secure all insurance, and shall furnish all certificates, endorsements and bonds required by the Contract Documents within ten (10) calendar days after receipt of the forms from the City. Failure or refusal to execute the Public Works Contract as herein provided or to conform to any of the stipulated requirements in connection therewith shall be just cause for annulment of the award and forfeiture of the Bid security. If the lowest responsive, responsible Bidder refuses or fails to execute the Public Works Contract, the City may award the Contract to the second lowest responsive, responsible Bidder. If the second lowest responsive, responsible Bidder refuses or fails to execute the Public Works Contract, the City may award the contract to the third lowest responsive, responsible Bidder. On the failure or refusal of such second or third lowest Bidder to execute the Agreement, each such Bidder's Bid securities shall be likewise forfeited to the City.

21. BID PROTEST PROCEDURES:

- A. Form of Protest. In order to be considered, a Protest shall be in writing, addressed and delivered to the attention of the project manager at the City of Mercer Island, 9611 SE 36th Street, Mercer Island, Washington 98040. The Protest shall include the following:
 - i. The name, address, and phone number of the Bidder protesting, or the authorized representative of the Bidder;
 - ii. A complete, detailed statement of all grounds for protest, supporting authority, and any supporting documentation. Supplemental information will not be considered unless the supplementation contains information not available at the time of protest;
 - iii. The specific ruling or relief requested; and
 - iv. Evidence that all persons with a financial interest in the procurement have been given notice of the Protest or if such persons are unknown, a statement to that effect.

- B. Who May Protest:
 - i. Protests based on specifications: Any prospective Bidder.
 - ii. Protests following Bid opening: Any Bidder with a substantial financial interest in the award of a Contract.

- C. Time to Protest:
- i. Protests based on specifications or other terms in the Contract Documents must be received by the City no later than ten (10) calendar days prior to the date established for submittal of Bids.
 - ii. The City must receive protests based on other circumstances within five (5) calendar days after the bids are opened and publicly read.
 - iii. In no event shall a Protest be considered if all bids are rejected or after execution of the Contract.
- D. Determination of Protest. Upon receipt of a timely written Protest, the City shall investigate the Protest and shall respond in writing to the Protest prior to the award of Contract. If protest is submitted in accordance with the procedures set forth above, the City will not execute a contract any sooner than two (2) business days after the City's decision on the Protest.
- E. Failure to Comply. Failure to comply with the procedures set forth herein may render a Protest untimely or inadequate and may result in rejection thereof by the City.
- F. Exhaustion of Administrative Remedies. By submitting a bid, the Bidder agrees the Bidder's compliance with the protest procedures set forth herein are a mandatory condition precedent to the Bidder initiating a lawsuit against the City.
- G. Venue. By submitting a bid, the Bidder acknowledges and agrees that a lawsuit or action related to or arising out of this procurement shall be brought in the Superior Court of King County, Washington.

Bidder's Checklist

ALL BIDDERS must properly complete, execute and submit the following with their bids:

1. **NON-COLLUSION DECLARATION:** Failure to submit the certificate shall make the bid non-responsive and not eligible for award.
2. **BID FORM:** Bidders must bid on all items contained in the Bid Form and the Form must be signed. The omission or deletion of any bid item may render the bid non-responsive and result in the rejection of the bid. Bidders are reminded to comply with RCW 39.30.060.
3. **CONTRACTOR DECLARATION PURSUANT TO RCW 39.04.350(2):** Failure to submit the declaration shall make the bid non-responsive and not eligible for award.
4. **BID GUARANTY BOND:** Failure to furnish a bid deposit of a minimum of five percent (5%) shall make the bid non-responsive and not eligible for award.
5. **BIDDERS QUALIFICATION CERTIFICATE:** To be completed and signed. The City reserves the right to check all statements and to judge the adequacy of the bidder's qualifications.

To assist the City in the review of the responsible Bidder's qualifications, the Bidder(s) shall, within five (5) days of being requested to do so by the City, provide the information required in Evaluation of Bidder Responsibility of the Instructions to Bidders, including a statement in accordance with RCW 9A.72.085 verifying compliance with responsible bidder criteria requirement of RCW 39.04.350(1)(g).

The **SUCCESSFUL BIDDER** shall properly complete, execute (as required) and submit the following after receiving notice of the award of the Project.

1. Public Works Contract,
2. Performance Bond,
3. Payment Bond,
4. Certificate of Insurance,
5. Retainage Agreement,
6. Statement of Intent to Pay Prevailing Wages,
7. Other documents requested by City.

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BIDDING REQUIREMENTS

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Non-Collusion Declaration

Project Name: Booster Chlorination System

Bidder/Contractor: _____

I, _____, declare under penalty of perjury under the laws of the State of Washington that the following statements are true and correct:

1. I am the representative for the above-named bidder/contractor, and as its _____, I am authorized to make the declaration herein on its behalf.
2. That the undersigned person(s), firm, association or corporation has (have) not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding in connection with the project for which this proposal is submitted.

Date and Place

Signature

BID FORM

(NOTE TO BIDDER: This BID FORM shall be completed in ink or typewritten)

TO: City of Mercer Island
ADDRESS: 9611 SE 36th Street
Mercer Island, Washington 98040
PROJECT TITLE: Booster Chlorination System

Bidder Declaration and Understanding

The undersigned Bidder hereby declares that they have carefully examined the Contract Documents for the construction of the project, that they have personally inspected the site, that they have satisfied themselves as to the quantities involved, including materials and equipment, and conditions of work involved, including the fact that the description of the quantities of work and materials, as included herein, is brief and is intended only to indicate the general nature of the work and to identify the quantities with the detailed requirements of the Contract Documents, and that this Proposal is made according to the provisions and under the terms of the Contract Documents, which Documents are hereby made a part of this Proposal. The Bidder further declares that they have exercised their own judgment regarding the interpretation of subsurface information and has utilized all data, which they believe pertinent from the Engineer, Owner, and other sources and have made such independent investigations as the Bidder deems necessary in arriving at their conclusions.

The Bidder is hereby notified that no goal for disadvantaged business enterprise utilization has been established for this project. As part of the City's affirmative action effort, however, the City encourages participation of certified disadvantaged businesses and women business enterprises to act as prime contractors as well as subcontractors on this project.

The undersigned Bidder hereby declares that Bidder has carefully examined the Contract Documents including the following addenda, receipt of all is hereby acknowledged:

Addendum Number	_____	Date	_____
	_____		_____
	_____		_____
	_____		_____

Start of Construction and Contract Completion Time

The Bidder agrees that he will begin work within 10 calendar days of the Notice to Proceed, and Final Completion of the entire project will be achieved by the Final Completion Date (except for extensions of time granted in accordance with the General Terms and Conditions). The Bidder further agrees he/she will, if necessary, accelerate his work, provide additional workers and equipment, and expedite materials delivery to meet these dates, all at no additional expense to the OWNER.

By submitting this bid, the bidder agrees that, if award this contract, they will achieve Final Completion within 310 calendar days from the Notice to Proceed and the Substantial Completion Date shall be 280 calendar days from Notice to Proceed.

Critical Dates (assumes NTP issued no later than 8/23/21):

Submit Sodium Hypochlorite Generators: 9/6/2021

Submit Temporary Pump System: 9/6/2021

Order Sodium Hypochlorite Generators: 10/6/2021

Complete Sodium Hypochlorite Generator Commissioning: 5/30/2022

Complete PS Phase 1 and 2: 1/5/2022

Complete PS Phase 3 (Temporary Pumping): 1/12/2022

Complete PS Phase 4 (yard piping): 1/29/2022

Start PP Phase 1: 1/15/2022

Lump Sum or Unit Price Work

The Bidder proposes to accept as full payment for the work proposed herein the amounts computed under the provisions of the Contract Documents and based on the following lump sum or unit price amounts, it being expressly understood that the unit prices are independent of the exact quantities involved. The Contractor shall be compensated for the actual unit quantities performed in accordance with the General Terms and Conditions set forth in these Contract Documents. The Bidder agrees that the lump sum prices and the unit prices represent a true measure of the labor, services, and materials required to perform the work, including all allowances for Contractor-paid taxes, overhead, and profit for each type and unit of work, as well as any auxiliary costs associated with completing a unit of work called for in these Contract Documents. The City does not guarantee the quantities estimated for unit price items, nor does the City limit itself to the estimated number.

If any material, item, or service required by the Contract Documents has not been mentioned specifically, the same shall be furnished and placed with the understanding that the full cost to the Owner has been merged with the prices named in the Proposal.

To the extent possible, standard bid items have been utilized for the work listed in the Proposal. The Bidder is directed to review the Standard Specifications and the technical specifications for descriptions of bid item work, measurement, and payment, including Section 01_11_00 – Summary of Work.

Bid Schedule

A single contract will be awarded to the responsible bidder submitting the lowest bid for Schedule A, taking into account the Bidder’s Qualifications and other bidding requirements.

The City of Mercer Island reserves the rights to reject all bids and/or to modify the size of the project. The Additive Alternate - Schedule B will be awarded to the lowest bidder of Schedule A, if the total bid price is within budgeted funds.”

Schedule A

Bid Item #	Bid Item	Quantity	Unit	Unit Cost	Total Cost
A1	West Yard Piping Installation and Modification	1	LS	LS	
A2	East Yard Piping Installation and Modification	1	LS	LS	
A3	Pump Station Piping Work	1	LS	LS	
A4	Sodium Hypochlorite Generation System Installation	1	LS	LS	
A5	Reservoir Tank Mixers Installation	1	LS	LS	
A6	Electrical and I&C Equipment Installation and Integration	1	LS	LS	
A7	89 th Ave SE Piping Installation and Modification	1	LS	LS	
A8	Fire Hydrant Installation and Modification	1	LS	LS	
A9	Pressure Relief Valve and Flow Meter Vault Replacement and Installation	1	LS	LS	
A10	Decommissioning of Existing Water Main	1	LS	LS	
A11	Traffic Control Measures	1	LS	LS	
A12	Backfill Materials - 5/8” Minus Crushed Rock	700	Ton		
A13	Hot Mix Asphalt - Class B	30	Ton		
A14	Traffic Flagger	360	Hour		
Subtotal Bid:					
Sales Tax (10.1%):					
Schedule A Total Bid:					

Additive Alternate - Schedule B

Bid Item #	Bid Item	Quantity	Unit	Unit Cost	Total Cost
B1	West Yard Piping Installation and Modification	1	LS	LS	
Sales Tax (10.1%):					
Additive Alternate - Schedule B Total Bid:					

Subcontractor Listing – RCW 39.30.060

Pursuant to RCW 39.30.060, the Bidder shall list as part of its Bid either itself or the names of the subcontractors with whom the Bidder, if awarded the contract, will subcontract for performance of the work of heating, ventilation and air conditioning (“HVAC”), plumbing as described in chapter 18.106 RCW, and electrical as described in chapter 19.28 RCW. The Bidder shall not list more than one subcontractor for each category of work.

Failure of the Bidder to submit as part of the Bid the names of such subcontractors or to name itself to perform such work or the naming of two or more subcontractors to perform the same category of work shall render the Bidder’s Bid nonresponsive and therefore, void.

The requirement of this section to name the Bidder’s proposed HVAC, plumbing, and electrical subcontractors applies only to proposed HVAC, plumbing, and electrical subcontractors who will contract directly with the general contractor submitting the Bid to the City.

Electrical work must be performed by a licensed electrical contractor. Bidders are cautioned that installation of electrical equipment (PVC or metal conduit, junction boxes or similar work) may be considered electrical work even if for future use and no electrical current is involved.

If the subcontract work categories as described above are not applicable to the work being bid, the bidder must indicate that the subcontract category is “NOT APPLICABLE.”

HVAC

Subcontractor Name: _

UBI Number: _

Plumbing

Subcontractor Name: _

UBI Number: _

Electrical

Subcontractor Name: _

UBI Number: _

PROPOSAL SIGNATURE SHEET

If Sole Proprietor, Partnership or Joint Venture

IN WITNESS hereto the undersigned have set their hands this

_ day of _____, 20 ____ .

Name of Bidder (name each partner
or joint venture partner) _____

Washington Contractor's Registration
No. _____

Address _____

Authorized Signature _____

Position/Title _____

If Corporation or Limited Liability Company (LLC)

IN WITNESS WHEREOF the undersigned corporation has caused this instrument to be executed and its seal
affixed by its duly authorized officers this

_ day of _____, 20 ____ .

Name of Corporation or Limited
Liability Company (LLC) _____

Washington Contractor's Registration
No. _____

Address _____

State of Incorporation or Organization _____

Authorized Signature _____

Position/Title _____

BID GUARANTY BOND

KNOW ALL BY THESE PRESENTS: That we, _____,
as Principal, and _____, as Surety, are jointly and severally held
and firmly bound unto the City of Mercer Island, hereinafter called the Obligee, each in the penal sum of
five percent (5%) of the Principal's Total Bid Price for the work, this sum not to exceed
_____ DOLLARS (\$_____) (hereinafter referred to as "penal sum") of
lawful money of the United States, for the payment whereof unto the Obligee.

WHEREAS, the Principal is herewith submitting its bid proposal for the

Booster Chlorination System Project

NOW, THEREFORE, the condition of this obligation is such that if the Principal is awarded the Contract,
and if the Principal, within the time specified, fulfills all of the requirements of the Contract Documents
which are conditions precedent to the execution of the Agreement, enters into, executes and delivers to the
Obligee an agreement on the form provided herein complete with evidences of insurance, and if the
Principal, within the time specified, gives to the Obligee the performance and payment bond on the forms
provided herein, then this obligation shall be void; otherwise, the Principal and Surety shall pay unto the
Obligee the penal sum; provided however, in no event shall the Surety's liability exceed the penal sum.
Provided further, if the difference in money between the Principal's Total Bid Price and the amount for
which the Obligee legally contracts with another party to fulfill the Contract is greater than the penal sum,
the Principal shall pay unto the Obligee the difference between the penal sum and the amount the Obligee
pays another to fulfill the Contract.

AND IT IS HEREBY DECLARED AND AGREED that the Surety shall be liable under this obligation as
Principal, and that nothing of any kind or nature whatsoever that will not discharge the Principal shall
operate as a discharge or a release of liability of the Surety.

IT IS HEREBY FURTHER DECLARED AND AGREED that this obligation shall be binding upon and inure
to the benefit of the Principal, the Surety and the Obligee and their respective heirs, executors,
administrators, successors and assigns.

SIGNED this _____ day of _____, 20_____.

Principal: _____ Surety: _____

By: _____ By: _____

Title: _____ Title: _____

Address: _____ Address: _____

Telephone: () _____ Telephone: () _____

Note: A power of attorney must be provided which appoints the Surety's true and lawful attorney-in-fact to make, execute, seal and deliver this bid guaranty bond.

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Bidder's Qualification Certificate

The undersigned hereby certifies and submits the following:

Company Name _____

Address _____

Owner Name _____

Contact Person _____

Contact Person's Title _____

Phone _____

E-mail _____

Washington State Contractor Registration # _____

Washington State Unified Business Identifier (UBI) # _____

Federal Tax ID # _____

City of Mercer Island Business License #
(required prior to award of contract) _____

	Yes or No	Account / Registration Number (as applicable)
Does the contractor have industrial insurance coverage for its employees working in Washington as required by Title 51 RCW?	_____	_____
Does the contractor have a Washington State excise tax registration number as required by Title 82 RCW?	_____	_____
Does the contractor have a Washington State Employment Security Department number as required by Title 50 RCW?	_____	_____
Has the contractor been disqualified from bidding on any public works contract under RCW 39.06.010 or 39.12.065(3)?	_____	_____
Has the contractor received training on the requirements related to public works contracts and prevailing wage requirements pursuant to RCW 39.04.350(f) and chapter 39.12 RCW, or is the contractor otherwise exempt from this requirement by the department of labor and industries?	_____	_____
Within the three-year period immediately preceding the date of the bid solicitation, has the contractor been determined by a final and binding citation and notice of assessment issued by the Department of Labor and Industries or through a civil judgment entered by a court of limited or general jurisdiction to have willfully violated, as defined in RCW 49.48.082, any provision of Chapters 49.46, 49.48, or 49.52 RCW?	_____	_____

By:

Signature
Title

Print Name
Date

Contractor Declaration Pursuant to RCW 39.04.350(2)

Project Name:

Bidder/Contractor:

I, _____, declare under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct:

1. I am the representative for the above-named bidder/contractor, and as its _____, I am authorized to make the declaration herein on its behalf.

2. Within the three-year period immediately preceding the date of the bid solicitation for the above-named project, the above-named bidder/contractor has not been determined by a final and binding citation and notice of assessment issued by the department of labor and industries or through a civil judgment entered by a court of limited or general jurisdiction to have willfully violated, as defined in RCW 49.48.082, any provision of chapter 49.46, 49.48, or 49.52 RCW.

Date and Place

Signature

AGREEMENT FORMS

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**PUBLIC WORKS CONTRACT
FOR
BOOSTER CHLORINATION SYSTEM PROJECT**

THIS PUBLIC WORKS CONTRACT ("Contract") dated _____, 20____, is effective on the date the Contract is fully executed by the Parties. The Parties to this Contract are the CITY OF MERCER ISLAND, a Washington municipal corporation ("City" or "Owner"), and _____, a Washington Corporation ("Contractor").

A. The City desires to retain an independent contractor to furnish all labor and materials necessary to perform work at Booster Chlorination System Project, Mercer Island, Washington ("Property"); and

B. The Contractor has the requisite skill and experience to perform such work and has submitted a proposal dated _____, 20____ to complete such work ("Proposal").

NOW, THEREFORE, the parties ("Parties") agree to the following terms and conditions:

1. SERVICES BY CONTRACTOR

1.1 Description of Work. Contractor shall perform all work and furnish all tools, materials, supplies, equipment, labor and other items incidental thereto necessary for the construction and completion of the work, more particularly described in the Contract Documents for the Booster Chlorination System Project, including this Public Works Contract, the Contractor's completed Bid Form, the City's General Terms and Conditions (May 2020 ed.), any Supplemental and/or Special Conditions, Technical Specifications, Drawings and Addenda, which documents are incorporated by this reference, ("Work"), which Work shall be completed to the City's satisfaction, within the time period prescribed by the City and pursuant to the direction of the City Manager or his or her designee.

1.2 Completion Date. The Work shall be commenced within ten (10) days of receipt by the Contractor of the City's Notice to Proceed and shall be Substantially Completed by _____, (the "Contract Time") as may be extended in accordance with the Contract Documents. In the event the Work is not completed within the time specified, Contractor agrees to pay to the City liquidated damages in the amount set forth in Section 1.3 of this Contract.

1.3 Liquidated Damages. TIME IS OF THE ESSENCE OF THIS CONTRACT. Delays inconvenience the residents of Mercer Island and cost taxpayers undue sums of money, adding time needed for administration, engineering, inspection and supervision. It is impractical for the City to calculate the actual cost of delays. Accordingly, the Contractor agrees to pay liquidated damages as follows: Liquidated damages for failure to achieve timely Substantial Completion shall be in the amount of \$1,000 per day.

1.4 Performance Standard. Contractor shall perform the Work in a manner consistent with accepted practices for highly skilled and competent contractors performing this type of work in this area.

1.5 Compliance with Laws. Contractor shall perform the Work in accordance with all applicable federal, state and City laws, including but not limited to all City ordinances, resolutions, standards or policies, as now existing or hereafter adopted or amended, and obtain all necessary permits and pay all permit, inspection or other fees, at its sole cost and expense.

1.6 Utility Location. Contractor is responsible for locating any underground utilities affected by the Work and is deemed to be an excavator for purposes of Chapter 19.122 RCW, as amended. Contractor shall be responsible for compliance with Chapter 19.122 RCW, including utilization of the "one call" locator system before commencing any excavation activities.

1.7 Air Environment. Contractor shall fully cover any and all loads of loose construction materials including without limitation, sand, dirt, gravel, asphalt, excavated materials, construction debris, etc., to protect said materials from air exposure and to minimize emission of airborne particles to the ambient air environment within the City of Mercer Island.

2. TERM

This Contract shall commence on the effective date of this Contract and continue until the Work is complete, and formally accepted by City, and all warranties have expired.

3. REQUISITE SKILL

The Contractor warrants that it has the requisite skill to complete the Work, and is appropriately accredited and licensed by all applicable agencies and governmental entities, including but not limited to being registered to do business in the City of Mercer Island by obtaining a City of Mercer Island business registration. Contractor represents that it has visited the site and is familiar with all of the plans and specifications in connection with the completion of the Work.

4. COMPENSATION

4.1 Total Compensation. In consideration of the Contractor performing the Services, the City agrees to pay the Contractor an amount not to exceed _____ Dollars (\$ _____), based on the Proposal submitted by Contractor dated _____ and as may be adjusted under the Contract Documents.

4.2 Contractor Responsible for Taxes. Except as otherwise stated in the Contract Documents, the Contractor shall be solely responsible for the payment of any taxes imposed by any lawful jurisdiction as a result of the performance and payment of this Contract.

4.3 Method of Payment. Payment by the City for the Work will only be made after the Work has been completed, a voucher or invoice is submitted in a form satisfactory to the City, and such invoice is approved by the appropriate City

representative. Payment shall be made within thirty (30) days of receipt of such invoice or voucher unless otherwise set forth in the Bid Form. The Contractor's acceptance of such payment for the Work shall constitute full compensation for the performance of the Work. Invoices shall be submitted to:

City of Mercer Island
9611 S.E. 36th Street
Mercer Island, WA 98040
ATTN: (staff), (title)

4.4 Retainage. Pursuant to Chapter 60.28 RCW, five percent (5%) of the Total Compensation shall be retained by the City to assure payment of Contractor's state taxes as well as payment of subcontractors, suppliers and laborers. Upon execution of this Contract, Contractor shall complete, execute and deliver to the City the Contractor's Retainage Agreement set forth in the Contract Documents. No payments shall be made by the City from the retained percentage fund ("Fund") nor shall the City release any retained percentage escrow account to any person, until the City has received from the Department of Revenue a certificate that all taxes, increases, and penalties due from the Contractor and all taxes due and to become due with respect to the Contract have been paid in full or that they are, in the Department's opinion, readily collectible without recourse to the State's lien on the retained percentage. Upon non-payment by the general contractor, any supplier or subcontractor may file a lien against the retainage funds, pursuant to Chapter 60.28 RCW. Subcontractors or suppliers are required to give notice of any lien within thirty (30) days of the completion of the Work and in the manner provided in RCW 39.08.030. Within sixty (60) days after completion of all Work on this Contract, the City shall release and pay in full the money held in the Fund, unless the City becomes aware of outstanding claims made against this Fund.

5. EQUAL OPPORTUNITY EMPLOYER

In all Contractor services, programs or activities, and all Contractor hiring and employment made possible by or resulting from this Contract, there shall be no discrimination by Contractor or by Contractor's employees, agents, subcontractors or representatives against any person because of sex, sexual orientation, age (except minimum age and retirement provisions), race, color, creed, national origin, marital status or the presence of any disability, including sensory, mental or physical handicaps, unless based upon a bona fide occupational qualification in relationship to hiring and employment. This requirement shall apply, but not be limited to the following: employment, advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship. Contractor shall not violate any of the terms of Chapter 49.60 RCW, Title VII of the Civil Rights Act of 1964, the Americans With Disabilities Act, Section 504 of the Rehabilitation Act of 1973 or any other applicable federal, state or local law or regulation regarding non-discrimination. Any material violation of this provision shall be grounds for termination of this Contract by the City and, in the case of the Contractor's breach, may result in ineligibility for further City agreements.

6. INDEPENDENT CONTRACTOR/CONFLICT OF INTEREST

It is the intention and understanding of the Parties that the Contractor shall be an independent contractor and that the City shall be neither liable nor obligated to pay Contractor sick leave, vacation pay or any other benefit of employment, nor to pay any social security or other tax which may arise as an incident of employment. The Contractor shall pay all income and other taxes as due. Industrial or any other insurance which is purchased for the benefit of the City, regardless of whether such may provide a secondary or incidental benefit to the Contractor, shall not be deemed to convert this Contract to an employment contract. It is recognized that Contractor may perform work during the Term of this Contract for other third parties; provided, however, that such performance of other work shall not conflict with or interfere with the Contractor's ability to perform the Work. Contractor agrees to resolve any such conflicts of interest in favor of the City.

7. INDEMNIFICATION

7.1 Indemnification and Hold Harmless.

- A. The Contractor shall protect, defend, indemnify, and hold harmless City, its elected officials, officers, agents and employees, from any and all claims, demands, suits, penalties, losses, damages, judgments, or costs of any kind whatsoever (hereinafter "claims"), arising out of or in any way resulting from the Contractor's officers, employees, agents, and/or subcontractors of all tiers, acts or omissions, performance or failure to perform this Contract, to the maximum extent permitted by law or as defined by RCW 4.24.115, now enacted or as hereinafter amended.
- B. The Contractor's obligations under this section shall include, but not be limited to,
 - i. The duty to promptly accept tender of defense and provide defense to City at the Contractor's own expense.
 - ii. The duty to indemnify and defend City, its elected officials, officers, agents and employees, from any claim, demand, and/or cause of action brought by or on behalf of any of its employees, or agents. The foregoing duty is specifically and expressly intended to constitute a waiver of the Contractor's immunity under Washington's Industrial Insurance Act, RCW Title 51, as respects City with a full and complete indemnity and defense of claims made by the Contractor's employees. The parties acknowledge that these provisions were mutually negotiated upon by them.
 - iii. To the maximum extent permitted by law, the Contractor shall indemnify and defend City, its elected officials, officers, agents and employees, from and be liable for all damages and injury which shall be caused to owners of property on or in the vicinity of the work or which shall occur to any person or persons or property whatsoever arising out of the performance of this Contract, whether or not such injury or damage is

caused by negligence of the Contractor or caused by the inherent nature of the work specified.

- C. City may, in its sole discretion, (1) withhold amounts sufficient to pay the amount of any claim for injury, and/or (2) pay any claim for injury of which City may have knowledge, regardless of the formalities of notice of such claim, arising out of the performance of this Contract.
- D. Any amount withheld will be held until the Contractor secures a written release from the claimant, obtains a court decision that such claim is without merit, or satisfies any judgment on such claim. In addition, the Contractor shall reimburse and otherwise be liable for claims costs incurred by City, including, without limitation, costs for claims adjusting services, attorneys, engineering, and administration.
- E. In the event City incurs any judgment, award, and/or costs arising therefrom, including attorneys' fees, to enforce the provisions of this article, all such fees, expenses, and costs shall be recoverable from the Contractor.
- F. This provision has been mutually negotiated by the City and the Contractor.

7.2 Survival. The provisions of this Section shall survive the expiration or termination of this Contract with respect to any event occurring prior to such expiration or termination.

8. INSURANCE

The Contractor agrees to carry as a minimum, the following insurance against claims for injuries to persons or damage to property which may arise from or in connection with the performance of the Work by Contractor, its agents, representatives, employees or subcontractors with a carriers having a current A.M. Best rating of not less than A:VII:

8.1 Workers' Compensation and Employer's Liability Insurance in amounts sufficient pursuant to the laws of the State of Washington.

8.2 Commercial general liability insurance shall be written on Insurance Services Office (ISO) occurrence form CG 00 01 and shall cover liability arising from premises, operations, independent contractors, products-completed operations, stop gap liability, personal injury and advertising injury, and liability assumed under an insured contract. The Commercial General Liability insurance shall be endorsed to provide the Aggregate Per Project Endorsement ISO form CG 25 03 11 85. There shall be no endorsement or modification of the Commercial General Liability insurance for liability arising from explosion, collapse or underground property damage. The City shall be named as an additional insured under the Commercial General Liability insurance policy with respect to the Work performed for the City using ISO Additional Insured endorsement CG 20 10 10 01 and Additional Insured Completed Operations endorsement CG 20 37 10 01 or substitute endorsements providing equivalent coverage with limits of no less

than \$1,000,000 each occurrence, \$2,000,000 general aggregate and a \$2,000,000 products-completed operations aggregate limit.

8.3 Automobile liability insurance covering all owned, non-owned, hired and leased vehicles. Coverage shall be written on ISO form CA 00 01 or a substitute form providing equivalent liability coverage. If necessary, the policy shall be endorsed to provide contractual liability coverage with combined single limits for bodily injury and property damage of not less than \$1,000,000 per accident.

8.4 Asbestos Abatement or Hazardous Materials. If asbestos abatement or hazardous materials work is performed, Contractor shall review coverage with the City Attorney's office and provide scope and limits of coverage that are appropriate for the scope of Work and are satisfactory to the City. Contractor shall not commence any Work until its coverage has been approved by the City Attorney's office.

The City shall be named as additional insured on all such insurance policies, with the exception of workers' compensation coverages. Contractor shall provide certificates of insurance, concurrent with the execution of this Contract, evidencing such coverage and, at City's request, furnish the City with copies of all insurance policies and with evidence of payment of premiums or fees of such policies. All insurance policies shall contain a clause of endorsement providing that they may not be terminated or materially amended during the Term of this Contract, except after thirty (30) days prior written notice to the City. 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 same insurance requirements as stated herein for the Contractor. Contractor's failure to maintain such insurance policies shall be grounds for the City's immediate termination of this Contract.

The provisions of this Section shall survive the expiration or termination of this Contract with respect to any event occurring prior to such expiration or termination.

9. PERFORMANCE/PAYMENT BOND OR ADDITIONAL RETAINAGE

Pursuant to RCW 39.08.010, Contractor shall provide Performance Bond and Payment Bond each in an amount equal to 100% of the amount of this Contract to cover the performance of all provisions of this Contract and the payment of all laborers and suppliers. The Contract bonds shall be in a form set forth in the Contract Documents. The Contract bond shall assure that the Contractor will faithfully perform all of the provisions of the Contract as well as pay all laborers, mechanic subcontractors, materialmen and suppliers. Contractor's obligations under this Contract shall not be limited to the bond amount.

Alternatively, pursuant to RCW 39.08.010, on contracts of Fifty-Five Thousand Dollars (\$55,000) or less, at the option of the Contractor, the City may, in lieu of a bond, retain ten percent (10%) of the Contract amount for a period of thirty (30) days after the date of final acceptance, or until receipt of all necessary releases from the Department of Revenue and the Department of Labor and Industries and settlement of any liens filed under Chapter 60.28 RCW, whichever is later.

10. SAFETY

Contractor shall take all necessary precautions for the safety of its employees on the work site and shall comply with all applicable provisions of federal, state and municipal safety and health laws and codes, including without limitation, all OSHA/WISHA requirements, Safety and Health Standards for Construction Work (Chapter 296-155 WAC), General Safety and Health Standards (Chapter 296-24 WAC), and General Occupational Health Standards (Chapter 296-62 WAC). Contractor shall erect and properly maintain, at all times, all necessary guards, barricades, signals and other safeguards at all unsafe places at or near the Work for the protection of its employees and the public, safe passageways at all road crossings, crosswalks, street intersections, post danger signs warning against known or unusual hazards and do all other things necessary to prevent accident or loss of any kind. Contractor shall protect from damage all water, sewer, gas, steam or other pipes or conduits, and all hydrants and all other property that is likely to become displaced or damaged by the execution of the Work. The Contractor shall, at its own expense, secure and maintain a safe storage place for its materials and equipment and is solely responsible for the same.

11. PREVAILING WAGES

11.1 Wages of Employees. This Contract is subject to the minimum wage requirements of Chapter 39.12 of the Revised Code of Washington, as now existing or hereafter amended or supplemented. In the payment of hourly wages and fringe benefits to be paid to any of Contractor's laborers, workpersons and/or mechanics, Contractor shall not pay less than the "prevailing rate of wage" for an hour's work in the same trade or occupation in the locality within the State of Washington where such labor is performed, as determined by the Industrial Statistician of the Department of Labor and Industries of the State of Washington. Prevailing wages paid pursuant to this Agreement shall be the prevailing wage rates which are in effect on the date when the bids, proposals, or quotes were required to be submitted to the City.

The State of Washington prevailing wage rates applicable for this public works project, which is located in King County, may be found at the following website address of the Department of Labor and Industries: <https://fortress.wa.gov/lni/wagelookup/prvWagelookup.aspx>. A copy of the applicable prevailing wage rates are also available for viewing at the office of the City located at 9611 SE 36th St, Mercer Island, WA 98040. Upon request, the City will mail a hard copy of the applicable prevailing wages for this project.

11.2 Reporting Requirements. Contractor shall comply with all reporting requirements of the Department of Labor and Industries of the State of Washington. Upon the execution of this Contract, Contractor shall complete and file a Statement of Intent to Pay Prevailing Wages with the Department of Labor and Industries. If requested by the City, the Contractor shall provide certified payroll records for its employees and the employees of its subcontractors. Upon completion of the Work, Contractor shall complete and file an Affidavit of Wages Paid with the Department of Labor and Industries. Contractor shall deliver copies of both the Statement of Intent to Pay Prevailing Wages

and the Affidavit of Wages Paid, certified by the Department of Labor and Industries, to the City.

12. SUBCONTRACTOR RESPONSIBILITY

Contractor shall verify responsibility criteria for each first tier subcontractor, and a subcontractor of any tier that hires other subcontractors must verify responsibility criteria for each of its subcontractors. Verification shall include that each subcontractor, at the time of subcontract execution, meets the responsibility criteria listed in the Instructions to Bidders and possesses an electrical contractor license, if required by chapter 19.28 RCW, or an elevator contractor license, if required by chapter 70.87 RCW. This verification requirement must be included in every public works subcontract or every tier.

13. OWNERSHIP OF DOCUMENTS

All originals and copies of work product, including plans, sketches, layouts, designs, design specifications, records, files computer disks, magnetic media, all finished or unfinished documents or material which may be produced or modified by Contractor while performing the Work shall become the property of the City and shall be delivered to the City at its request.

14. CONFIDENTIALITY

If it is necessary to provide proprietary information, the Contractor shall clearly mark the information on each page of the document(s) as "Proprietary and Confidential". The City is subject to laws regarding the disclosure of public records and document. Proposals and other materials, submitted by the Contractor become public record and may be subject to public disclosure, in whole or in part, and may be released by the City in the event of a request for disclosure. In the event the City receives a public record request for information and the Contractor has marked the requested document as "Proprietary and Confidential", the City shall notify the Contractor of such request and withhold disclosure of such information for not less than five (5) business days, to permit the Contractor to seek judicial protection of such information; provided that the Contractor shall be solely responsible for all attorney fees and costs in such action and shall save and hold harmless the City from any costs, attorneys fees or penalty assessments under Chapter 42.56 RCW for withholding or delaying public disclosure of such information.

15. BOOKS AND RECORDS

The Contractor agrees to maintain books, records, and documents which sufficiently and properly reflect all direct and indirect costs related to the performance of this Contract and such accounting procedures and practices as may be deemed necessary by the City to assure proper accounting of all funds paid pursuant to this Contract. These records shall be subject at all reasonable times to inspection, review or audit by the City, its authorized representative, the State Auditor, or other governmental officials authorized by law to monitor this Contract.

16. CLEAN UP

At any time ordered by the City and immediately after completion of the Work, the Contractor shall, at its own expense, clean up and remove all refuse and unused materials of any kind resulting from the Work. In the event the Contractor fails to perform the necessary clean up, the City may, but in no event is it obligated to, perform the necessary clean up and the costs thereof shall be immediately paid by the Contractor to the City and/or the City may deduct its costs from any remaining payments due to the Contractor.

17. GENERAL PROVISIONS

This Contract, the Contract Documents and any supporting contract documents contain all of the agreements of the Parties with respect to any matter covered or mentioned in this Contract and no prior agreements or understandings shall be effective for any purpose. No provision of this Contract may be amended except by written agreement of the Parties. Any provision of this Contract which is declared invalid, void or illegal shall in no way affect, impair, or invalidate any other provision hereof and such other provisions shall remain in full force and effect. The Contractor shall not transfer or assign, in whole or in part, any or all of its obligations and rights hereunder without the prior written consent of the City. In the event the City consents to any such assignment or transfer, such consent shall in no way release the Contractor from any of its obligations or liabilities under this Contract. Subject to the preceding sentence, this Contract shall be binding upon and inure to the benefit of the Parties' successors in interest, heirs and assigns. In the event the City or the Contractor defaults on the performance of any terms in this Contract, and the Contractor or City places the enforcement of the Contract or any part thereof, or the collection of any monies due, in the hands of an attorney, or files suit, each Party shall pay all its own attorneys' fees and expenses. The venue for any dispute related to this Contract shall be King County, Washington. Failure of the City to declare any breach or default immediately upon occurrence thereof, or delay in taking any action in connection with, shall not waive such breach or default. This Contract shall be governed by and interpreted in accordance with the laws of the State of Washington. Each individual executing this Contract on behalf of the City and Contractor represents and warrants that such individuals are duly authorized to execute this Contract. Time is of the essence of this Contract and each and all of its provisions in which performance is a factor. Adherence to completion dates is essential to the Contractor's performance of this Contract.

IN WITNESS WHEREOF, the Parties have executed this Contract the _____ day
of _____, 20__ .

CITY OF MERCER ISLAND

By: Jessi Bon, City Manager

ATTEST:

Deborah A. Estrada, MMC, City Clerk

APPROVED AS TO FORM:

Bio Park, City Attorney

(Name of Contractor)

By: (Signature)

(Signature Name and Title)

(Address)

(Phone)

**PERFORMANCE BOND
To City of Mercer Island, WA**

Bond No. _____

The City of Mercer Island, Washington has awarded to _____ (Principal), a contract for the construction of the project designated as

Project No. _____, in Mercer Island, Washington (Contract), and said Principal is required to furnish a bond for performance of all obligations under the Contract.

The Principal, and _____ (Surety), a corporation, organized under the laws of the State of _____ and licensed to do business in the State of Washington as surety and named in the current list of "Surety Companies Acceptable in Federal Bonds" as published in the Federal Register by the Audit Staff Bureau of Accounts, U.S. Treasury Dept., are jointly and severally held and firmly bound to the City, in the sum of _____ US Dollars (\$ _____) Total Contract Amount, subject to the provisions herein.

This statutory performance bond shall become null and void, if and when the Principal, its heirs, executors, administrators, successors, or assigns shall well and faithfully perform all of the Principal's obligations under the Contract and fulfill all terms and conditions of all duly authorized modifications, additions, and changes to said Contract that may hereafter be made, at the time and in the manner therein specified; and if such performance obligations have not been fulfilled, this bond shall remain in force and effect.

The Surety for value received agrees that no change, extension of time, alteration or addition to the terms of the Contract, the specifications accompanying the Contract, or to the work to be performed under the Contract shall in any way affect its obligation on this bond, and waives notice of any change, extension of time, alteration or addition to the terms of the Contract or the work performed. The Surety agrees that modifications and changes to the terms and conditions of the Contract that increase the total amount to be paid the Principal shall automatically increase the obligation of the Surety on this bond and notice to Surety is not required for such increased obligation.

This bond may be executed in two (2) original counterparts, and shall be signed by the parties' duly authorized officers. This bond will only be accepted if it is accompanied by a fully executed and original power of attorney for the office executing on behalf of the surety.

PRINCIPAL

SURETY

Principal Signature Date

Surety Signature Date

Printed Name Date

Printed Name Date

Title

Title

Name, address, and telephone of local office/agent of Surety Company is:

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PAYMENT BOND
to City of Mercer Island, WA

Bond No _____

The City of Mercer Island, Washington has awarded to _____ (Principal), a contract for the construction of the project designated as _____, Project No. _____, in Mercer Island, Washington (Contract), and said Principal is required under the terms of that Contract to furnish a payment bond in accord with Title 39.08 Revised Code of Washington (RCW) and (where applicable) 60.28 RCW.

The Principal, and _____ (Surety), a corporation organized under the laws of the State of _____ and licensed to do business in the State of Washington as surety and named in the current list of "Surety Companies Acceptable in Federal Bonds" as published in the Federal Register by the Audit Staff Bureau of Accounts, U.S. Treasury Dept., are jointly and severally held and firmly bound to the City, in the sum of _____ US Dollars (\$ _____) Total Contract Amount, subject to the provisions herein.

This statutory payment bond shall become null and void, if and when the Principal, its heirs, executors, administrators, successors, or assigns shall pay all persons in accordance with RCW 39.08, 39.12, and 60.28 including all workers, laborers, mechanics, subcontractors, and materialmen, and all person who shall supply such contractor or subcontractor with provisions and supplies for the carrying on of such work, and all taxes incurred on said Contract under Titles 50 and 51 RCW and all taxes imposed on the Principal under Title 82 RCW; and if such payment obligations have not been fulfilled, this bond shall remain in full force and effect.

The Surety for value received agrees that no change, extension of time, alteration or addition to the terms of the Contract, the specifications accompanying the Contract, or to the work to be performed under the Contract shall in any way affect its obligation on this bond, and waives notice of any changes, extension of time, alteration or addition to the terms of the Contract or the work performed. The Surety agrees that modifications and changes to the terms and conditions of the Contract that increase the total amount to be paid the Principal shall automatically increase the obligation of the Surety on this bond and notice to Surety is not required for such increased obligation.

This bond may be executed in two (2) original counterparts, and shall be signed by the parties' duly authorized officers. This bond will only be accepted if it is accompanied by a fully executed and original power of attorney for the office executing on behalf of the surety.

PRINCIPAL

SURETY

Principal Signature Date

Surety Signature Date

Printed Name Date

Printed Name Date

Title

Title

Name, address, and telephone of local office/agent of Surety Company is:

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RETAINAGE AGREEMENT

Contract Title _____

Contract Date _____
Contractor Name _____
Contractor Address _____

Contractor Phone _____
Contractor Federal ID # _____

State Law on How Contract Retainage Monies can be Reserved:

RCW 60.28.010 Retained percentage, labor and material Contracts for public improvements or work other than for professional services, provides that there shall be reserved by the city from the monies earned by the contractor on estimates during the progress of the improvement or work, a sum of five percent of such estimates, said sum to be retained by the city as a trust fund for the protection and payment of any persons performing work or supplying provisions or supplies during the work. The monies reserved for contract retainage may be reserved by the contractor choosing one of the following four options:

All investments selected below are subject to City approval.

Contractor Options (Contractor shall place an "x" in one of the boxes below.)

- (a) Retained in a non-interest bearing fund by the public body until released in accordance with applicable state statutes;
- (b) Deposited by the public body in an interest bearing account in a bank, mutual savings bank, or savings and loan association, not subject to withdrawal until released in accordance with applicable state statutes, provided that interest on such account shall be paid to the contractor;
- (c) Placed in escrow with a bank or trust company by the public body until released in accordance with applicable state statutes. The cost of the investment program and the risk thereof is to be borne entirely by the contractor.
- (d) Contractor may submit a Retainage Bond equal to 5% of the total awarded bid amount for all schedules to be held by the public body until released in accordance with applicable state statutes.

Contractor's Bank

If Contractor selects options (b) or (c) above, Contractor shall designate below the bank in which the retainage is to be deposited:

ACCOUNT NO. _____
BANK NAME _____
BANK ADDRESS _____
BANK PHONE # _____

Agreement

Contractor and City agree that all or part of the monies in the account can only be approved for disbursement by Bank to Contractor upon written authorization of the City Finance Director, or his/her authorized designee.

By _____
City of Mercer Island

By _____
Contractor

Date _____

Date _____

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**CITY OF MERCER ISLAND
GENERAL TERMS AND CONDITIONS
MAY 2020 EDITION
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ARTICLE 1: GENERAL PROVISIONS

1.1 DEFINITIONS

- A. **“Addendum”** or **“Addenda.”** Alteration or clarification of the plans or specifications provided to bidders by City prior to bid time, which becomes part of the Contract Documents when the Contract is executed.
- B. **“Claim.”** A written demand by the Contractor seeking (1) a change to Contract Price; (2) a change of Contract Time; (3) a payment of money or damages; and/or, (4) any other relief arising out of or relating to this Contract.
- C. **“Change Order.”** A written instrument designated to be a Change Order which alters the Contract, and identifies the following: (1) a change in the Work; (2) a change in Contract Price; and/or (3) a change in Contract Time.
- D. **“Change Proposal.”** A document prepared by the Contractor at the request of City, which proposes changes to the Work and/or changes to the Contract Price and/or Contract Time. City initiates all requests for Change Proposals.
- E. The **“Contract”** or **“Contract Documents.”** The entire integrated agreement between City and the Contractor for the performance of the Work in accordance with the Contract Documents. The Contract Documents include the following:
 - 1. The signed Agreement between City and Contractor (the “Public Works Contract”);
 - 2. The Contractor’s completed Bid Form;
 - 3. The City’s General Terms and Conditions (May 2020 ed.);
 - 4. Any Supplemental or Special Conditions.
 - 5. Technical Specifications;
 - 6. Drawings;
 - 7. Addenda; and
 - 8. Any Change Orders.
- F. **“Contract Execution.”** occurs when City Manager or his/her designee signs the Contract, which shall only occur after the Contractor signs the Contract.
- G. **“Contract Price”** means the total amount payable by City to the Contractor for performance of the Work in accordance with the Contract.
- H. **“Contract Time.”** The number of days or the specific date set forth in the Contract to achieve Substantial Completion of the Work.
- I. **“Contract Work”** or **“Work.”** The labor, supervision, materials, equipment, supplies, services, other items, and requirements of the Contract necessary for the execution, completion and performance of all requirements of the Contract by the Contractor to the satisfaction of City.
- J. **“Contractor.”** The individual, association, partnership, firm, company, corporation, or combination thereof, including joint ventures, contracting with City to do the Contract Work.

- K. **“Critical Path.”** The longest, continuous sequence of interrelated activities that begins at the start of the Project (Notice to Proceed) and extends to Substantial Completion of the Project. These activities are critical because delay to an activity on this path will extend Contract Time.
- L. **“Day.”** A calendar day, unless otherwise specified.
- M. **“Differing Site Conditions.”** (1) Subsurface or latent physical conditions at the site which differ materially from those indicated in the Contract Documents (Type I), or (2) Unknown physical conditions at the Site, of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inherent in the construction activities of the character provided for in the Contract (Type II).
- N. **“Engineer.”** The City representative who administers the Contract for the City.
- O. **“Final Acceptance.”** Written acceptance of the Project by City.
- P. **“Force Majeure.”** An event that is unforeseeable at the time of Contract Execution and that is beyond the reasonable control of the Contractor and City and includes:
1. Natural Disaster declared by Governor of Washington or President of the United States, including but not limited to earthquakes;
 2. Acts or omissions of any government entity acting within its governmental capacity;
 3. Fire and/or flood for which the Contractor or its Subcontractors is not responsible;
 4. Quarantine or epidemic;
 5. Strike or defensive lockout;
 6. Unusually Severe Weather Conditions; and
 7. Acts of terrorism.
- Q. **“Hazardous Material.”** Any pollutant, contaminant, toxic or hazardous waste, dangerous substance, potentially dangerous substance, noxious substance, toxic substance, flammable material, explosive material, radioactive material, urea formaldehyde foam insulation, asbestos, PCBs, or any other substances the removal of which is required, or the manufacture, preparation, production, generation, use, maintenance, treatment, storage, transfer, handling, or shipment of which is restricted, prohibited, regulated, or penalized by any and all federal, state, City, or municipal statutes or laws and regulations promulgated thereunder, now or at any time hereafter in effect, including, but not limited to, the Comprehensive Environmental Response, Compensation, and Liability Act (42 U. S. C. §§ 9601, *et seq.*), the Hazardous Materials Transportation Act (49 U. S. C. §§ 1801, *et seq.*), the Resource Conservation and Recovery Act (42 U. S. C. §§ 6901, *et seq.*), the Federal Water Pollution Control Act (33 U. S. C. §§ 1251, *et seq.*), the Clean Air Act (42 U. S. C. §§ 7401, *et seq.*), the Toxic Substances Control Act, as amended (15 U. S. C. §§ 2601, *et seq.*), the Occupational Safety and Health Act (29 U. S. C. §§ 651, *et seq.*, and the Model Toxics Control Act (RCW 70.105), or similar state or local statute or code), as the laws have been amended and supplemented.
- R. **“City”** or **“Owner”** may be used interchangeably and refer to the City of Mercer Island.

- S. **“Notice.”** A written document issued by the Engineer or Contractor’s Representative which is submitted to the other party and delivered by:
1. Depositing in the U. S. Mail (or other method of commercial express mail), which notice shall be effective on the date of receipt;
 2. Service on the Parties’ representative or at the Contractor’s home office or field office, which notice shall be effective on the date of service; or,
 3. Facsimile to the Parties’ representative or Contractor’s home office or field office, which notice shall be effective upon receipt.
- T. **“Notice To Proceed.”** A written directive issued by City authorizing the Contractor to perform some or all of the Work.
- U. **“Overhead.”** Charges that may be incurred or allocated in support of the Contract but are not part of the cost of directly performing the physical Contract construction activity. Overhead includes Site or Field Overhead and Home Office Overhead.
1. **Site or Field Office Overhead**
Site or Field Overhead costs are typically those costs that are related to, but are not limited to supervision, including general foremen and their supervisors, planners, schedulers, engineers, managers, etc. and the direct payroll costs of their project-related service, clerical salaries and their direct payroll costs, the costs of all vehicles, travel, meal and lodging costs associated with those personnel, Site or Field office and utility expense, expenses associated with all regulatory compliance, Hand and Other Small Tools provided by the Contractor for the use of its forces, all expendable supplies, and all other items incidental to or integral in supporting the physical completion of the Work.
 2. **Home Office Overhead**
Home office Overhead costs are typically those that include all general office expenses. Such costs include, but are not limited to those associated with officer and office salaries and related payroll taxes and benefits, costs of office occupancy and maintenance, all supporting services (such as utilities, office machines computers, and related items and support) related to the home office function, business taxes and licenses, and all such other costs necessary to operate the business entity. Home office overhead includes unabsorbed home office overhead.
 3. In addition to the above, whether treated as Site or Field Overhead or as Home Office Overhead, costs of any and all bonds, insurance(s), and taxes associated with this Contract are to be considered as Overhead. All items as those identified above are to be treated as Overhead for this purpose regardless of how the Contractor chooses to account for them in its books of account.
 4. Under no circumstances shall City pay the Contractor for direct or allocated costs or charges for officer bonus and profit sharing, project personnel bonuses, charitable contributions, income taxes, or any costs relating to illegal activity.
- V. **“Parties.”** The Contractor and City.
- W. **“Project.”** All activity relative to this Contract including activity of the Contractor, its Subcontractors, and City.

- X. **“Request for Change Order.”** A document, designated as a Request for a Change Order, prepared by the Contractor requesting either (1) a change in Contract Price; (2) a change in Contract Time; (3) a change in t Work; (4) a payment of money or damages; and/or, (5) any other relief arising out of or relating to this Contract.
- Y. **“Request for Information.”** A request from the Contractor to City seeking an interpretation or a clarification of some requirement of the Contract Documents.
- Z. **“Site” or “Project Site.”** The location, at which construction, equipment or services furnished by the Contractor under the Contract will be performed, completed and/or delivered.
- AA. **“Subcontractor.”** An individual, firm, partnership, or corporation having a contract, purchase order, or agreement with the Contractor, or with any Subcontractor of any tier for the performance of any part of the Contract. When City refers to Subcontractor(s) in this document, for purposes of this document and unless otherwise stated herein, the term Subcontractor(s) includes, at every level and/or tier, all subcontractors and subconsultants.
- BB. **“Supplier(s).”** Any person or firm who is not performing work or supplying labor on Site and is engaged in the business of supplying a manufactured product or resource to City, Contractor, or Subcontractors. The term Suppliers includes materialmen, manufacturers, and fabricators.
- CC. **“Substantial Completion.”** That stage in the progress of the Work where:
 1. City has full and unrestricted use and benefit of the Project for the purpose intended;
 2. All the systems and parts of the Contract Work are functional;
 3. Utilities are connected and operate normally;
 4. Only minor incidental work or correction or repair remains to complete all Contract requirements; and
 5. The City has received all certificates of occupancy and any other permits, approvals, licenses and other documents from any governmental authority with jurisdiction necessary for beneficial occupancy of the project.

1.2 INTENT AND INTERPRETATION OF THE DOCUMENTS

- A. The Contract Documents constitute the entire and integrated agreement between the parties hereto and supersede all prior negotiations, representations, or agreements, either written or oral.
- B. The Contract Documents shall not be construed to create a contractual relationship between any parties other than City and the Contractor. No contract between City and a third party shall be construed to create any duty on the part of City or such third party to the Contractor. The Contractor is not an intended or incidental beneficiary of any promises made in City’s contract with a third party, if any.
- C. The Contract Documents are intended to be complementary. What is required by one part of the Contract shall be as binding as if required by all. Should any conflict or inconsistency be found in the Contract Documents, the provision imposing the more expensive duty or obligation on the Contractor shall take precedence.

- D. The words “similar,” “typical” (or other equivalents) shall mean nearly corresponding or having a likeness. Such words shall not be construed to mean that all parts of the Work referred to are identical or substantially identical, or that such elements of the Work are connected identically or substantially identically to the rest of the Work. The Contractor has the responsibility to determine all details of the Work in relation to their location and connection to other parts of the Work. The singular includes the plural and vice versa. Male includes female and vice versa.
- E. The organization of the specifications into divisions, provisions and articles and the organization of the drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

1.3 CLARIFICATION OF DRAWINGS AND DETAIL DRAWINGS

- A. Where on any drawing a portion of the Work is drawn out and the remainder is indicated in outline, the drawn out parts shall apply also to other similar portions of the Work. Where ornament or other detail is indicated by starting only, such detail shall be continued throughout the courses or parts in which it occurs and shall apply to all other similar parts of the Work, unless otherwise indicated.
- B. With regard to drawings the following shall apply:
 - 1. Written dimensions shall be followed; drawings may not be to scale.
 - 2. Figure dimensions on drawings shall govern over scale dimensions; and detail drawings shall govern over general drawings.

ARTICLE 2: CITY

2.1 AUTHORITY

- A. Unless City, in writing, indicates otherwise, the authority to (1) commit to or bind City to any Change Orders or change in the Work, Contract Price and/or Contract Time; or (2) sign the Contract or Change Orders rests solely in the City Manager or his or her designee.
- B. The Engineer shall have the authority to administer the Contract. Administration of the Contract by the Engineer includes but is not limited to:
 - 1. Receiving all correspondence and information from the Contractor;
 - 2. Issuing request for Change Proposals;
 - 3. Responding to Requests For Information;
 - 4. Reviewing the schedule of values, project schedules, submittals, testing and inspection reports, substitution requests, and other documentation submitted by the Contractor;
 - 5. Negotiating Change Proposals and Change Orders;
 - 6. Recommending Change Orders for approval by the City Manager or its designee;
 - 7. Issuing decisions with respect to Requests for Change Orders and Claims;
 - 8. Processing payment requests submitted by the Contractor, and recommending payment;

9. Monitoring the quality of the Work, rejecting noncompliant Work, and recommending acceptance of the Work;
 10. Transmitting executed Change Orders, amendments, and other Contract correspondence to the Contractor; and
 11. Performing all other contract administrative functions.
- C. All correspondence, questions, and/or documentation shall be submitted to the Engineer.
- D. The Engineer may designate representatives to perform functions under the Contract, such as review and/or inspection and acceptance of supplies, services, including construction, and other functions of a technical or administrative nature.

2.2 INFORMATION SUPPLIED BY CITY

- A. Unless otherwise specifically provided in the Contract, surveys and site information provided by City are intended to describe the general physical characteristics of the Site. City does not represent that this information is complete or sufficient for the Contractor's performance of the Work.
- B. City shall furnish to the Contractor a copy of the Contract Documents. The Contractor shall pay City for any additional copies of Contract Documents.

2.3 WORK BY CITY OR SEPARATE CONTRACTORS

City reserves the right to perform work not included in the Contract or to let other contracts in connection with this Project. The Contractor shall coordinate its Work with City and other City contractors and, at City's request, participate in meetings for the purpose of coordinating the Contractor's construction schedule with those of other contractors at no additional cost to City.

ARTICLE 3: CONTRACTOR

3.1 CONTRACTOR REPRESENTATIONS

The Contractor makes the following representations to City:

- A. Before submission of its bid, the Contractor has:
1. Carefully reviewed the Contract Documents, and visited and examined the Site;
 2. Become familiar with the general and local conditions in which the Work is to be performed, and satisfied itself as to the nature, location, character, quality and quantity of Contract Work, the labor, materials, equipment, goods, supplies, work, services and other items to be furnished and all other requirements of the Contract Documents, as well as the surface and reasonably ascertainable subsurface conditions and other matters that may be encountered at the Site or affect performance of the Work or the cost or difficulty thereof;
 3. Become familiar with and satisfied itself as to the conditions bearing upon transportation, disposal, handling, and storage of materials; and
 4. Become familiar with and satisfied itself as to the availability of labor, water, electric power, and roads; and the uncertainties of access, traffic, parking and weather. Any failure of the Contractor to take the action described in this provision (3.0) or elsewhere in the Contract Documents will not relieve the Contractor from responsibility for estimating properly the difficulty and cost of

successfully performing the Work, or for proceeding to successfully perform the Work without additional expense to City.

- B. The Contract Price is reasonable compensation for the Work and the Contract Time is adequate for the performance of the Work as represented by the Contract, site visit, and the general conditions (including but not limited to weather, site, soil) known or reasonably anticipated for the Site.

3.2 GENERAL DUTIES

- A. The Contractor shall give sufficient supervision to the Work, using its best skill and attention. The Contractor is on notice that City will be relying on the accuracy, competence and completeness of the Work. The Contractor shall supervise and be solely responsible for the proper performance of the Work in accordance with the Contract, including the construction means, methods, techniques, sequences, procedures, and for coordination of all portions of the Work.
- B. Unless specified elsewhere in the Contract, the Contractor shall provide and pay for all labor, materials, equipment, tools, construction machinery, utilities, transportation, and other facilities and services (including federal and state tax, industrial insurance, social security liability and all other applicable taxes) necessary for the proper execution and completion of the Work.
- C. The Contractor shall also provide sufficient staffing and supervision to process Requests for Information, Change Proposals, Submittals, Change Orders, close out documentation, and to perform all other requirements of the Contract and all Work.
- D. The Contractor shall lay out its Work from baselines and benchmarks indicated in the Contract, if any, and shall be responsible for the accuracy of all field measurements and surveys used in the lay out.

3.3 DUTY TO INSPECT CONTRACT DOCUMENTS

- A. The Contractor shall carefully study and compare all Contract Documents and check the conditions, dimensions, and instructions as stated therein. Contractor will not be required to provide professional services which constitute the practice of architecture and engineering except to the extent provided for in the technical specifications and drawings.
- B. The Contractor shall immediately notify City in writing of any:
 - 1. Error, inconsistency, or omission in the Contract Documents that a reasonable contractor knew or through the exercise of reasonable diligence should have discovered under the same and similar circumstances;
 - 2. Requirement in the Contract Documents that conflict with any local, state, and federal laws, regulations and/or permits, licenses, and easement conditions that a reasonable contractor knew or through the exercise of reasonable diligence should have discovered under the same and similar circumstances.
- C. The Contractor should not proceed with the work in question until the Contractor receives written direction from the Engineer.
- D. If the Contractor proceeds with the work in question without written direction from the Engineer, the Contractor shall be responsible for any costs or damages associated with:

1. Fines or penalties;
2. Demolition, tear out, removal, cleanup, remediation, or fixing the work in question; and
3. Delay, disruption, and loss of productivity.

3.4 CONTRACTOR'S SUPERVISION AND EMPLOYEES

- A. Contractor shall provide qualified and competent people to administer the contract and perform all the Work.
- B. During performance of the Work the Contractor shall have supervisory personnel on-site and available to administer, manage and coordinate the Work. City shall not be responsible for the acts or omissions of the supervisory personnel or their assistants.
- C. The Contractor shall at all times enforce good order among all persons furnishing labor or materials on-site and shall only employ workers skilled in the work assigned. If requested by the Project Representative, Contractor shall provide the Project Representative with copies of licenses, registrations, and certifications.
 1. City shall have the right to require the Contractor to remove personnel from the Site that do not have the appropriate qualifications and experience to meet or uphold the requirements of the Contract. City shall also have the right to order the Contractor to replace personnel who demonstrate unprofessional behavior.
 2. Failure by City to require removal of any Contractor personnel shall not be deemed an admission that any such personnel are satisfactory, nor shall such failure relieve the Contractor from any contractual responsibility.

3.5 SUBCONTRACTORS AND SUPPLIERS

- A. This Contract is between City and the Contractor.
 1. The Contractor's subcontracting shall not create a contract between City and the Subcontractor and Suppliers. Subcontractors and Suppliers are not intended as incidental third party beneficiaries to the Contract. The Subcontractor and Suppliers shall have no rights against City by reason of their agreements with the Contractor.
 2. The Contractor is responsible for performing all work required by the Contract. The Contract has not been written with the intent of, and City shall not be a party to, defining the division of work between the Contractor and its Subcontractors and Suppliers.
- B. **Selection of Subcontractors and Suppliers**
 1. Subcontractors and Suppliers shall be properly licensed, registered or certified, as applicable, and capable to perform the assigned work.
 2. If requested by City, the Contractor shall provide documentation that the proposed Subcontractors and Suppliers have adequate experience and skill.
 3. The Contractor shall require each Subcontractor and Supplier to comply with all provisions of this Contract. At the request of Subcontractors or Suppliers, Contractor shall make available for copying all Contract Documents.

C. Responsibility for Work of Subcontractors and Suppliers

The Contractor shall be responsible for the acts and omissions of Subcontractors and Suppliers. The Contractor shall also be responsible for the suitability of any materials, components, equipment or supplies furnished by a Subcontractor and/or Supplier irrespective of whether such were designated or approved by City.

3.6 SCHEDULE OF WORKING HOURS

- A. As specified in the Contract, the Contractor shall submit a schedule of working hours, including overtime to City for acceptance. This schedule shall comply with all Contract requirements. Except as permitted elsewhere in the Contract Documents or in the case of an emergency, all Work at the Site shall be performed between the hours of 7am and 6 pm Monday through Friday.
- B. The schedule of working hours accepted by City shall be the only schedule used by the Contractor during performance of the Contract, unless amended to maintain Work progress.
- C. The Contractor shall provide 48 hours advance written Notice of any intent to work outside of approved working hours. Any work at the Site performed outside approved working hours shall be performed without additional expense to City, except as otherwise provided in the Contract Documents. Contractor shall comply with Mercer Island Code Section 8.24.020 (Q) which prohibits construction related noise outside designated hours except in cases of emergency or demonstrated necessity.

3.7 RECORD DOCUMENTS

- A. The Contractor shall maintain an accurate, readable, and orderly set of drawings and specifications, updated as the job progresses to show all approved changes, options, alternates, and all actual deviations from the original Contract Documents. This set of drawings and specifications shall be the Record Documents.
 - 1. The Record Documents shall be maintained in hard copy.
 - 2. In addition to all approved changes, options, alternates, and all actual deviations from the original Contract Documents, the Record Documents shall be marked as follows:
 - a. Record all materials used where options, alternates and/or change orders were indicated, specified and/or authorized;
 - b. Accurate measurements referenced as required by the technical specifications shall be recorded to show the exact location and changes in direction of all underground services and utilities, as well as their depth below finished grade; and
 - c. Record all other requirements as specified in the Technical Specifications.
- B. The Record Documents shall be kept up-to-date and be available for review by City at all times, including but not limited to at each job progress meeting. Failure to have the record set up-to-date shall be sufficient reason for City to withhold payment in accordance with paragraph 7.2, *Payments Withheld*, until all such information is recorded.

- C. Record Documents may be used to assist City to verify the appropriate progress payment.
- D. Neither Final Acceptance nor Final Payment will be issued until a complete set of Record Documents is submitted and the Engineer is satisfied as to its quality and accuracy.

3.8 COST RECORDS

- A. The Contractor, Subcontractors, and Suppliers shall maintain Project cost records by cost codes and shall segregate and separately record at the time incurred all costs (1) directly associated with each work activity and (2) directly or indirectly resulting from any event or condition for which the Contractor seeks an adjustment in the Contract Price, Contract Time, and/or damages.
 - 1. Any costs claimed to result from any such event or condition, including, but not limited to, delay and impact costs, acceleration costs, loss of productivity or efficiency, and increased or extended overhead shall be recorded at the time incurred and be fairly and reasonably allocated to each such event or condition and to other causes of such costs.
 - 2. City shall be provided with a detailed description of all such costs and the basis of allocation. The Contractor, Subcontractors, and Suppliers shall maintain a monthly summary of all costs and shall make all underlying cost records and monthly summary of costs available for review, inspection, and copying by City upon request.
 - 3. Any work performed for which the Contractor intends to seek an adjustment in Contract Price and/or Contract Time shall be recorded on the same day the work is performed and kept separate so as to distinguish it from Contract Work.
- B. In addition to the requirements set forth in Article 5, *Changes to the Contract*, and Article 6, *Time and Price Adjustments*, the Contractor shall be entitled to extra compensation for an event or condition and/or the recovery of damages only to the extent that the Project cost records are kept in full compliance with all Contract requirements and the cost allocations support entitlement to such compensation.

3.9 MAINTENANCE AND INSPECTION OF DOCUMENTS

- A. All Contractor's, Subcontractors', and Suppliers' documents and records relating to the Contract shall be open to inspection, audit, and/or copying by City or its designee:
 - 1. During the Contract Time; and
 - 2. For a period of not less than six years after the date of Final Acceptance of the Contract ("Preservation Period"); or if any Claim, audit or litigation arising out of, in connection with, or related to this Contract is initiated, all documents shall be retained until such Claim, audit or litigation involving the records is resolved or completed, whichever occurs later.
- B. The Contractor shall also guarantee that all Subcontractor and Supplier documents shall be retained and open to similar inspection, audit and/or copying during the Contract Time and also the Preservation Period. The Contractor, Subcontractor, and Supplier shall use its best efforts to cooperate with the inspection, auditing, and/or copying.

- C. Inspection, audit, and/or copying of all documents described herein, may be performed by City or its designee at any time with not less than seven (7) days' Notice. Provided however, if an audit or inspection is to be commenced more than sixty (60) days after the Final Acceptance date of the Contract, the Contractor will be given twenty (20) days' Notice of the date of the audit.
- D. The Contractor, Subcontractors, and Suppliers shall provide adequate facilities, acceptable to City, for inspection, auditing, and/or copying during normal business hours.
- E. If the Contractor is formally dissolved, assigns or otherwise divests itself of its legal capacity under this Contract, then it shall immediately notify City and preserve such records, at its expense, as directed by City.
- F. The Contractor, Subcontractor, and Supplier, shall be subject to audit at any time with respect to this Contract. Failure to maintain and retain sufficient records to allow City to verify all costs or damages or failure to permit City access to the books and records shall constitute a waiver of the rights of the Contractor Subcontractor and Supplier to Claim or be compensated for any damages, additional time or money under this Contract.
- G. At a minimum, the following documents, including the machine readable electronic versions, shall be available for inspection, audits, and/or copying:
 1. Daily time sheets and all daily reports, Supervisor's reports, and inspection reports;
 2. Collective bargaining agreements;
 3. Insurance, welfare, and benefits records;
 4. Payroll registers;
 5. Earnings records;
 6. All tax forms, including payroll taxes;
 7. Material invoices and requisitions;
 8. Material cost distribution worksheet;
 9. Equipment records (list of Contractor's, Subcontractors', and Suppliers' equipment, rates, etc.);
 10. Contracts, purchase orders and agreements between the Contractor and each Subcontractor and Supplier;
 11. Subcontractors' and Suppliers' payment certificates;
 12. Correspondence, including email, with Subcontractors and/or Suppliers;
 13. All meeting notes by and between Contractor, Subcontractors, Suppliers and/or any third parties related to the Project;
 14. Canceled checks (payroll and vendors);
 15. Job cost reports, including monthly totals;
 16. Job payroll ledger;
 17. Certified payrolls;

18. General ledger;
 19. Cash disbursements journal;
 20. Take off sheets, and calculations used to prepare the bid and/or quotes;
 21. Take off sheets, calculations, quotes, other financial data to support change proposals, request for change order and/or claims;
 22. Financial statements for all years during the Contract Time. In addition, City may require, if it deems appropriate, additional financial statements for 3 years preceding execution of the Contract and 6 years following Final Acceptance of the Contract;
 23. Depreciation records on all Contractor's, Subcontractor's, and Supplier's equipment, whether these records are maintained by the Contractor, Subcontractors, and Suppliers involved, its accountant, or others;
 24. If a source other than depreciation records is used to develop costs for the Contractor's internal purposes in establishing the actual cost of owning and operating equipment, all such other source documents;
 25. All documents which relate to each and every Claim together with all documents which support the amount of damages as to each Claim;
 26. Worksheets or software used to prepare the Claim establishing the cost components for items of the Claim including but not limited to labor, benefits and insurance, materials, equipment, Subcontractors, Suppliers, all documents which establish time periods, individuals involved, the hours for the individuals, and the rates for the individuals;
 27. Worksheets, software, and all other documents used (a) by the Contractor to prepare its bid and schedule(s) and/or (b) to prepare quotes and bids to the Contractor;
 28. All schedule documents, including electronic versions, planned resource codes, or schedules and summaries;
 29. All submittals; and
 30. All other documents, including email, related to the Project, Claims, or Change Orders.
- H. The Contractor shall mark any documentation it considers proprietary or confidential accordingly. Such information will be treated as such by City; however, City cannot ensure that this information will not be subject to release pursuant to a public records request. In the event City receives a request for such information, City will advise the Contractor and will not release the requested information for a period of not less than ten (10) days in order to give the Contractor an opportunity to obtain a court order prohibiting the release of the information in response to the public records request.

3.10 MAINTENANCE AND SITE CLEANUP

- A. The Contractor shall at all times keep the Site, access points, and public rights-of-way free from accumulation of dirt, mud, waste materials or rubbish caused by the Contractor or Subcontractors. At the completion of the Contract Work, the Contractor shall remove and lawfully dispose of all its dirt, mud, waste materials,

rubbish, tools, scaffolding and surplus or partly used materials from the Site and shall leave the Site broom clean unless some stricter standard is specified in the Contract.

- B. The Contractor shall obey all applicable laws and regulations relating to the storage, use, and disposal of Hazardous Materials. The Contractor shall promptly notify City of all Contractor or Subcontractor caused spills or releases of Hazardous Materials, and pay the cost to promptly clean up all such spills or releases and any associated fines or penalties. The Contractor shall maintain documentation of the clean up and disposal all Contractor or Subcontractor caused spills or releases of Hazardous Materials.
- C. If the Contractor fails to adequately maintain or cleanup the Site, City may, after written Notice to the Contractor, sweep surfaces or remove the dirt, mud, waste materials, rubbish, or hazardous materials and charge all reasonable costs of such work to the Contractor.

3.11 PROTECTION OF EXISTING STRUCTURES, EQUIPMENT, VEGETATION, UTILITIES, AND IMPROVEMENTS

- A. Contractor shall protect from damage all existing structures, curbs, gutters, sidewalks, equipment, improvements, utilities, trees, and vegetation not shown in the Contract Documents to be removed or modified at or near the Site. Contractor shall repair, at no cost to City, any such damage resulting from failure to comply with the requirements of the Contract or failure to exercise reasonable care in performing the Work. If Contractor fails or refuses to repair the damage promptly, City may have the necessary work performed and deduct or charge the cost to Contractor or exercise its rights under the Performance and Payment Bond. If there are insufficient funds remaining, excluding retention, the Contractor shall pay City for the costs associated with protection and repairing the damages.

3.12 PERMITS, LAWS, REGULATIONS AND TAXES

- A. Except those permits, easements, and variances specified in the Contract as having been previously obtained by City, all permits, licenses, easements and variances necessary for the execution of the Work shall be secured and paid for by the Contractor. The Contractor shall identify, apply for, and pay for such permits and licenses at the earliest possible time so as to avoid any delay to the Work arising from the permitting and/or licensing process. No actions taken by City to aid the Contractor in securing any permit or license shall relieve the Contractor of any obligations to secure any such permit or license.
- B. The Contractor shall maintain all stamped permit sets of documents at the Site during construction, in good condition and as required by local ordinances.
- C. The Contractor shall perform the Work in full compliance with local, state and federal laws, ordinances, resolutions and regulations, and with permit, license, easement, and variance conditions pertaining to the conduct of the Work. The Contractor shall defend, indemnify, and hold City, its elected officials, officers, agents and employees harmless from any assessment of fines, penalties, or damages arising from violations of the same by the Contractor or Subcontractors. The Contractor shall pay and provide proof of payment for any assessments of fines, penalties or damages. The Contractor shall cooperate with all governmental entities regarding inspection of the Work and compliance with such requirements.

- D. The bid form may include a line item for sales tax on the whole amount, or on items which are not exempt from tax under Washington State Department of Revenue rules, including WAC 458-20-170 and WAC 458-20-171. Unless there are separate line items in the bid form for Washington State sales tax, Contractor shall include all sales tax in its lump sum bid or unit prices. The Contractor should contact the Washington State Department of Revenue for answers to questions in this area. The City will not adjust its payment if the Contractor bases a bid on a misunderstood tax liability. Except as provided above, the Contractor is required to pay all applicable taxes. No adjustment will be made in the amount to be paid by City under the Contract because of any change in law or regulations covering any applicable taxes, or because of any misunderstanding by the Contractor as to its liability for or the amount of any taxes.

3.13 PATENTS AND ROYALTIES

- A. The Contractor shall assume all costs or fees relating to royalties or claims for any patented invention, article, process or method that may be used upon or in a manner connected with the Work under this Contract or with the use of completed Work by City.

3.14 CONTRACTOR'S CERTIFICATION

A. Conflict of Interest

The Contractor certifies (and shall require each Subcontractor to certify) that it has no direct or indirect pecuniary or proprietary interest, and that it shall not acquire any such interest, which conflicts in any manner or degree with the work, services or materials required to be performed and/or provided under this Contract and that it shall not employ any person or agent having any such interest. In the event that the Contractor or its agents, employees or representatives acquires such a conflict of interest, the Contractor shall immediately disclose such interest to City and take action immediately to eliminate the conflict or to withdraw from this Contract, as City may require.

B. Contingent Fees and Gratuities

The Contractor, by entering into this Contract with City to perform or provide work, services or materials, has thereby covenanted:

1. That no person or selling agency except bona fide employees or designated agents or representatives of the Contractor has been or will be employed or retained to solicit or secure this Contract with an agreement or understanding that a commission, percentage, brokerage, or contingent fee may be paid; and
2. That no gratuities, in the form of entertainment, gifts or otherwise, have been or will be offered or given by the Contractor or any of its agents, employees or representatives, to any official member or employee of City or other governmental agency with a view toward securing this Contract or securing favorable treatment with respect to the awarding or amending thereof, or the making of any determination with respect to the performance of this Contract. The Contractor certifies that it has not made any contributions to any person or entity as a condition of doing business with City and it has disclosed to City all attempts by any person to solicit such payments.

3.15 DEVIATION FROM CONTRACT

- A. The Contractor shall not make an alteration, variation, addition, deviation, or omission from the requirements of the Contract Documents without the prior written consent of the Engineer.
- B. Any alteration, variation, addition, deviation, or omission by the Contractor shall not result in any extra compensation or extension of time.

3.16 OPERATIONS, MATERIAL HANDLING, AND STORAGE AREAS

A. Temporary Buildings and Utilities

Temporary buildings (including storage sheds, shops, and offices) and utilities may be erected by Contractor on the Site only with the consent of City and without expense to City. The temporary buildings and utilities shall remain the property of Contractor and shall be removed by the Contractor at its expense upon completion of the Work.

B. Disposal/Removal of Materials

The Contractor shall be responsible for compliance with all laws governing the storage and ultimate disposal of all materials and components. The Contractor shall provide City with a copy of all manifests and receipts evidencing proper disposal when required by City or applicable law.

C. Protection and Care of Contractor's Materials and Equipment

The Contractor shall be responsible for the proper care and protection of its materials and equipment delivered to the Site. Materials and equipment may be stored on the Site at the Contractor's own risk and with prior written approval from City. When the Contractor uses any portion of the Site as a shop, the Contractor shall be responsible for any repairs, patching, or cleaning arising from such use and for obtaining any necessary permits to establish such shop or temporary storage facilities.

3.17 CONTRACTOR'S OVERALL RESPONSIBILITY FOR PROTECTION OF WORK, PROPERTY, AND PERSONS

- A. The Contractor shall be responsible for conditions of the Site, including safety of all persons and property, during performance of the Work. The Contractor shall maintain the Site and perform the Work in a manner which meets all statutory and common law requirements or other specific contractual requirements for the provision of a safe place to work and which adequately protects the safety of all persons and property on or near the Site. This obligation shall apply continuously and shall not be limited to normal working hours. City's inspection of the Work or presence at the Site does not and shall not be construed to include review of the adequacy of the Contractor's safety measures in, on or near the site of the Work.
- B. The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs, including adequate safety training, in connection with the Work. The Contractor shall comply with all applicable laws, ordinances, rules, regulations and lawful orders of any public authority bearing on the safety of persons or property or their protection from damage, injury or loss.
- C. The Contractor shall protect and be responsible for any damage or loss to the Work or to the materials and equipment associated with the Work until the date of

Substantial Completion. The Contractor remains responsible for any damage or loss caused directly or indirectly by the acts or omissions of the Contractor, Subcontractors, Suppliers, or third parties authorized or allowed on the Site by the Contractor until Final Acceptance.

- D. The Contractor shall also be solely and completely responsible for damages arising from the Work that affect property adjacent to the Site.
- E. The Contractor shall repair or replace without cost to City any damage or loss that may occur, except damages or loss caused by the acts or omissions of City.
- F. The Contractor shall erect and maintain adequate steel plates, signs, fencing, barricades, lights or security measures and persons to protect the Work until the Engineer authorizes in writing the removal of signs, fencing, barricades, lights or security measures.
- G. The Contractor shall conduct all operations with the least possible obstruction and inconvenience to the public. To disrupt public traffic as little as possible, the Contractor shall permit traffic to pass through the Project Site with the least possible inconvenience or delay. The Contractor shall maintain existing roads, streets, sidewalks and paths within the Project Site, keeping them open and in good, clean, safe condition at all times.

3.18 PROTECTION OF PERSONS

- A. The Contractor shall take all reasonable precautions for the safety of all employees working on this Contract and all other persons who may be affected by such Work. The Contractor shall designate a responsible member of its organization at the Site whose duty shall be to manage and coordinate the safety programs and to prevent accidents of the Contractor and Subcontractors.
- B. Except as otherwise stated in the Contract, if the Contractor encounters, on the Site, material reasonably believed to be Hazardous Material that Contractor shall immediately stop work in the area affected and give Notice of the condition to City. Work in the affected area shall not be resumed without written direction by City.
- C. To protect the lives and health of persons performing work under this Contract, the Contractor shall comply with the Federal Occupational Safety and Health Act of 1970 (OSHA), including all revisions, amendments and regulations issued thereunder, and the provisions of the Washington Industrial Safety Act of 1973 (WISHA), including all revisions, amendments and regulations issued thereunder by the Washington State Department of Labor and Industries including, without limitation, all excavation, tunneling, trenching and ditching operations. In case of conflict between any such requirements, the more stringent regulation or requirement shall apply. There is no acceptable deviation from these safety requirements, regardless of practice in the construction industry. Any violation of OSHA, WISHA or other safety requirements applicable to the Work may be considered a breach of this Contract.

3.19 SAFETY PROGRAM

The Contractor shall prepare and maintain a written site specific "Safety Program" demonstrating the methods by which all applicable safety requirements of this Contract will be met. The Contractor shall ensure its Subcontractors and Suppliers have a written "Safety Program" or formally adopt the Contractor's site specific "Safety Program." The

Contractor shall conduct a weekly safety meeting with all Subcontractors and others on the Site to discuss general and specific safety matters.

3.20 ARCHAEOLOGICAL AND HISTORICAL PRESERVATION

The Contractor shall comply fully with the requirements set forth in Chapter 27.53 RCW entitled Archaeological Sites and Resources. The Contractor shall immediately notify the City if any artifacts, skeletal remains or other archaeological resources (as defined under RCW 27.53.040 now and as hereinafter amended) are unearthed during excavation or otherwise discovered on the Site.

3.21 WATER POLLUTION CONTROL REQUIREMENTS

The Contractor shall comply with and be liable for all penalties, damages and violations under Chapter 90.48 RCW including any regulations issued pursuant thereto in the performance of the Work.

3.22 EASEMENTS

If the Contractor makes arrangements for use of additional public and/or private property, the Contractor, prior to using such property, shall provide the Engineer with written permission of the landowner, or duly authorized agent of such landowner, for such use.

3.23 TITLE VI / NONDISCRIMINATION ASSURANCES

During the performance of this contract, the contractor/consultant, for itself, its assignees and successors in interest (hereinafter referred to as the "contractor") agrees as follows:

1. Compliance with Regulations

The contractor shall comply with the Regulations relative to non-discrimination in federally assisted programs of United States Department of Transportation (USDOT), Title 49, Code of Federal Regulations, part 21, as they may be amended from time to time, (hereinafter referred to as the Regulations), which are herein incorporated by reference and made a part of this contract.

2. Non-discrimination

The contractor, with regard to the work performed by it during the contract, shall not discriminate on the grounds of race, color, sex, or national origin in the selection and retention of sub-contractors, including procurement of materials and leases of equipment. The contractor shall not participate either directly or indirectly in the discrimination prohibited by Section 21.5 of the Regulations, including employment practices when the contract covers a program set forth in Appendix B of the Regulations.

3. Solicitations for Sub-contracts, Including Procurement of Materials and Equipment

In all solicitations either by competitive bidding or negotiations made by the contractor for work to be performed under a sub-contract, including procurement of materials or leases of equipment, each potential sub-contractor or supplier shall be notified by the contractor of the contractor's obligations under this contract and the Regulations relative to non-discrimination on the grounds of race, color, sex, or national origin.

4. Information and Reports

The contractor shall provide all information and reports required by the Regulations or directives issued pursuant thereto, and shall permit access to its books, records,

accounts, other sources of information, and its facilities as may be determined by the contracting agency or the appropriate federal agency to be pertinent to ascertain compliance with such Regulations, orders and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish this information, the contractor shall so certify to WSDOT or the USDOT as appropriate, and shall set forth what efforts it has made to obtain the information.

5. Sanctions for Non-compliance

In the event of the contractor's non-compliance with the non-discrimination provisions of this contract, the contracting agency shall impose such contract sanctions as it or the USDOT may determine to be appropriate, including, but not limited to:

- Withholding of payments to the contractor under the contract until the contractor complies, and/or,
- Cancellation, termination, or suspension of the contract, in whole or in part.

6. Incorporation of Provisions

The contractor shall include the provisions of paragraphs (1) through (5) in every sub-contract, including procurement of materials and leases of equipment, unless exempt by the Regulations, or directives issued pursuant thereto. The contractor shall take such action with respect to any sub-contractor or procurement as the contracting agency or USDOT may direct as a means of enforcing such provisions including sanctions for non-compliance.

Provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a sub-contractor or supplier as a result of such direction, the contractor may request WSDOT enter into such litigation to protect the interests of the state and, in addition, the contractor may request the USDOT enter into such litigation to protect the interests of the United States.

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.1 TIME OF ESSENCE

All time requirements set forth in the Contract Documents are of the essence.

4.2 WORK PROGRESS

A. The Contractor shall be required to:

1. Prosecute the Work diligently with adequate forces;
2. Plan, coordinate, and layout the Work in advance so as to avoid delay; and
3. Achieve Substantial Completion of the Work and Final Acceptance in accordance with the requirements of Contract Documents.

4.3 SCHEDULE OF VALUES

A. Unless otherwise specified, within fourteen (14) days after the date of Contract Execution, the Contractor shall submit to City a detailed Schedule of Values that identifies the various activities of the Work and their values and quantities, including the overhead and profit for each activity. The Contractor warrants that the values identified in its Schedule of Values accurately reflect the value of each work activity. The Schedule of Values shall be used as a basis for calculating all Progress Payments. Payment for Contract Work shall be made only for and in accordance with those activities identified in the Schedule of Values.

- B. The Contractor shall not be entitled to, nor shall City be required to make, payment for any Contract Work until the Schedule of Values has been accepted by City. Such acceptance shall not be unreasonably withheld.
- C. City shall review and accept the Schedule of Values or provide the Contractor with a written explanation of why the Schedule of Values was not acceptable. City shall use reasonable efforts to review the Schedule of Values within thirty (30) days of City's receipt of the Contractor's submittal of its Schedule of Values. City's acceptance of the Schedule of Values shall not relieve the Contractor from its sole responsibility for the accuracy of the Schedule of Values and its compliance with all Contract requirements. The Contractor shall revise the Schedule of Values as necessary to accurately reflect Change Orders.
- D. Each Application for Payment shall include a current status of the Schedule of Values. No Application for Payment will be considered until the current status of the Schedule of Values has been submitted and accepted.
- E. The activities, which the Contractor identifies within its Schedule of Values, shall be specifically referenced within, and conform and be consistent with the activities set forth within the Project Schedule.

4.4 PROJECT SCHEDULE

- A. Unless otherwise specified, within fourteen (14) days after the date of Contract Execution, the Contractor shall submit to City a Project Schedule. The Project Schedule shall show the sequence in which the Contractor proposes to perform the Work, indicate the Critical Path, identify the dates on which the Contractor proposes to start and finish the scheduled activities of the Contract Work, indicate Substantial Completion within the Contract Time, indicate a date for Final Acceptance, and meet all the requirements as may be set forth in the Contract Documents.
- B. Within thirty (30) days of City's receipt of the Contractor's submittal of its Project Schedule or unless stated elsewhere in the Contract, City shall review the Project Schedule and provide the Contractor with written comments. City will review the Project Schedule only to determine whether the Project Schedule meets the requirements in the Technical Specifications on Project Schedule. To the extent the Project Schedule does not meet such Technical Specifications, the Contractor shall revise the Project Schedule to make it compliant.
- C. By reviewing the Project Schedule and providing written comments, City is not approving or adopting the Contractor's plan, schedule, means, methods, techniques, sequences, or procedures required to perform the Work. Review and comment by City of the Project Schedule shall not relieve the Contractor from the sole responsibility for the accuracy of a Project Schedule, and its compliance with all Contract requirements, and its responsibility to meet all required Contract completion dates. Failure by City to indicate items on the Project Schedule that do not conform with the Contract requirements shall not alter or waive the Contract requirements or relieve the Contractor from complying with all Contract requirements.
- D. The Contractor shall not be entitled to, nor shall City be required to make payment for any Contract Work until the Project Schedule complies with all Contract requirements.
- E. The Contractor shall schedule the Contract Work so that the Contract Work is completed within the Contract Time. Float in the project Schedule shall be defined as the period of time measured by the number of days each non-critical path

activity may be delayed before it and its succeeding activities become part of the Critical Path. Contractor and Owner may both utilize float to offset delays to the Work.

- F. The Contractor shall regularly enter the actual progress of the Work and Contract Time extensions, if any, approved by City on the Project Schedule. Updated Project Schedules shall reflect actual progress and completion within the Contract Time and shall be provided to City with each Application for Payment in format(s) as required by the Contract. Applications for Progress Payments will not be considered by City and the Contractor will not be paid until the Contractor complies with these requirements. The updated Project Schedule shall be used to assist City in verifying the appropriate payment.
- G. If, in the opinion of City, the Contractor falls behind in its progress of the Work due to acts or omissions of the Contractor, Subcontractors, and Suppliers, the Contractor shall take all necessary steps to improve its progress and bring its progress back in-line with the accepted Project Schedule, without additional cost to City. In this circumstance the Contractor shall, as necessary, increase the number of shifts, overtime operations, and/or days of work, both on and off the Site, and submit for acceptance any supplementary schedule or schedules as City deems necessary to demonstrate how the accepted rate of progress will be regained. Failure of the Contractor to comply with the requirements under these provisions shall be grounds for a determination by City that the Contractor is not prosecuting the Work with sufficient diligence to ensure completion within the time specified in the Contract. Upon making this determination, City may pursue any right it has under the law or the Contract, including but not limited to default termination.

4.5 SUBMITTALS

- A. Submittals include shop drawings, setting and erection drawings, schedules of materials, product data, samples, certificates and other information prepared for the Work by the Contractor or a Subcontractor as set forth in the Technical Specifications ("Submittals"). The Contractor shall perform no portion of the Work requiring Submittals until the Submittals have been reviewed and returned by City with one of the following annotations: (1) no exceptions taken, or (2) note markings.
- B. When submitting information, the Contractor shall identify and state reasons for any alteration, variation, addition, deviation, or omission from the Contract. The Contractor shall not perform work that alters, varies, adds to, deviates from, or omits any requirement of the Contract Documents without prior specific written acceptance by City.
- C. The Contractor shall provide Submittals with reasonable promptness and in such sequence as to facilitate the timely completion of the Contract.
- D. City shall review the Contractor's Submittals and respond in writing with reasonable promptness so as not to unreasonably delay the progress of the Work. Unless otherwise agreed, no delay to the Work shall be attributable to the failure by City to respond to a Submittal until thirty (30) days after the Submittal is received by City, and then only if failure by City to respond is unreasonable and affects the Contract completion date.
- E. If the Contractor is required to resubmit a Submittal, any revisions on resubmittals shall be specifically identified in writing and the resubmitted Submittal shall be sequentially alpha denoted (for example: 22A followed by 22B, etc.) and note revisions in numerical order. The cost of the review of the initial Submittal and the first revised submittal shall be borne by City. The costs of all

additional revised Submittals shall be charged to the Contractor. The cost of review shall include, without limitation, administrative, design, and engineering activities directly related to review of Submittals. City may deduct these costs from any amounts due the Contractor.

- F. City shall review the Contractor's Submittals only for conformance with the design of the Work and compliance with the Contract. Review of the Submittals are not conducted to verify the accuracy of dimensions, quantities, or calculations, the performance of materials, systems, or equipment, or construction means, methods, techniques, sequences, or procedures, all of which remain the Contractor's responsibility. Failure by City to take exception to a Submittal shall not relieve the Contractor from any duty, including its responsibility for errors or omissions in Submittals, its duty to make Submittals and duty to perform the Work according to the requirements of the Contract. City's review of a Submittal shall not alter or waive the requirements of the Contract unless City has issued prior written approval of such change or alteration of the Contract requirements.
- G. The Contractor's failure to identify any error, deviation, or omission and subsequent acceptance of the Submittal by City shall not relieve the Contractor from complying with the Contract requirements.

4.6 REQUESTS FOR INFORMATION

- A. If the Contractor determines that some portion of the drawings, specifications or other Contract Documents require clarification or interpretation by City because of an apparent error, inconsistency, omission, or lack of clarity in the Contract, the Contractor shall promptly submit a Request For Information ("RFI") and, unless otherwise directed, shall not proceed with the affected work until City has responded to the RFI. The Contractor shall plan its work in an efficient manner so as to allow for timely responses to RFIs.
- B. City shall respond in writing with reasonable promptness to Contractor's RFI.
 - 1. At the request of the Engineer, the Contractor shall prioritize its RFIs, identify a date by which the Contractor prefers the RFI be answered, and reasons for such priority.
 - 2. If the Contractor submits a RFI on an activity less than thirty (30) days prior to the commencement of that activity, the Contractor shall not be entitled to any time extension or adjustment in Contract Price due to the time it takes City to respond to the RFI provided that City responds within fifteen (15) days. No delay to the Work or damages to the Contractor shall be attributable to the failure by City to respond to the RFI until fifteen (15) days after City's receipt of the RFI, and then only if the failure by City to respond is unreasonable and affects the Contract completion date.
- C. City's response to a RFI shall not be considered a change to the Contract requirements unless it is accompanied by a Request for Change Proposal. If the Contractor believes that City's response to the RFI constitutes changed work impacting Contract Price or Contract Time, the Contractor shall submit a Notice of Claim, Supplemental Information and a Request for Change Order to City in accordance with Articles 5, *Changes to the Contract*.

4.7 TESTS, INSPECTIONS, AND ACCESS TO THE WORK

- A. Contractor shall be responsible for inspection and quality assurance of all the Work including all work performed by any Subcontractor. The Contractor shall document and maintain an adequate testing and inspection program and perform such tests and inspections as are necessary or required to ensure that the Work conforms to the requirements of the Contract. The Contractor shall maintain all documentation related to testing and inspection and make such documentation available to City at its request. Unless otherwise provided, Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to City, or with the appropriate public authority. If any governmental, regulatory, or permitting authority requires any portion of the Work to be inspected, tested, or approved, the Contractor shall make all arrangements for and cooperate with such inspections, tests, and approvals so as not to delay completion of the Work. The Contractor shall bear all related costs of tests, inspections, and approvals. The Contractor shall give City at least three (3) days' Notice of: (1) when the work is ready to be tested and inspected and (2) when and where tests and inspections are to be made. Contractor shall maintain complete inspection records and make them available to City upon request.
- B. The Contractor shall cooperate with City in the performance of any tests and inspections of the Work. The Contractor has the duty to coordinate all tests and inspections in a manner, which does not negatively impact Contractor's compliance with the Contract.
- C. If any Work required to be inspected, tested, or approved is covered without such inspection, testing or approval being obtained, it must, if requested by City, be uncovered for observation, and such uncovering shall be at Contractor's expense.
- D. City may, at any reasonable time and at its own cost, conduct inspections and tests as it deems necessary to ensure that the Work is in accordance with the Contract. City shall promptly notify Contractor if an inspection or test reveals that the Work is not in accordance with the Contract. City inspection and tests are for the sole benefit of City and do not:
 - 1. Constitute or imply acceptance;
 - 2. Relieve Contractor of responsibility for providing adequate quality control measures;
 - 3. Relieve Contractor of responsibility for risk of loss or damage to the Work, materials, or equipment;
 - 4. Relieve Contractor of its responsibility to comply with the requirements of the Contract; or
 - 5. Impair City's right to reject defective or nonconforming items, or to avail itself of any other remedy to which it may be entitled.
- E. Neither observations by an inspector retained by City, the presence or absence of such inspector on the Site, nor inspections, tests, or approvals by others, shall relieve Contractor from any requirement of the Contract. Inspectors are not authorized to change any term or condition of the Contract.
- F. Contractor shall promptly furnish, without additional charge, all facilities, labor, material and equipment reasonably needed for performing such safe and convenient inspections and tests as may be required by City. City may charge

Contractor any additional cost of inspection or testing when Work is not ready at the time specified by Contractor for inspection or testing, or when prior rejection makes reinspection or retest necessary. City shall perform its inspections and tests in a manner that will cause no undue delay in the Work.

4.8 CORRECTION OF WORK OR DAMAGED PROPERTY

- A. If material, equipment, workmanship, or work proposed for, or incorporated into the Work, does not meet the Contract requirements or fails to perform satisfactorily, City shall have the right to reject such work by giving the Contractor written notice and may require the Contractor to promptly repair, replace or correct it at no cost to the City.
- B. If the Contractor does not repair, replace or correct and/or remove defective or non-conforming Work or repair damaged property as required by City, in manner and/or schedule, City or City's designee may repair, replace or correct and/or remove it and deduct the cost of such effort from any payment due the Contractor.
 - 1. If the remaining payments due the Contractor are not sufficient to cover City's cost of remedying the defective or non-conforming Work, the Contractor shall pay the difference to City.
- C. The Contractor shall be liable for all damages and costs incurred by City caused by defective or non-conforming work or workmanship, including but not limited to all special, incidental, or consequential damages incurred by City.

4.9 SUBSTITUTION OF PRODUCTS & PROCESSES

- A. Substitutions requested by the Contractor will be subject to City's prior written acceptance and at City's sole discretion.
- B. Requests for substitution must specifically identify:
 - 1. Material, equipment, and labor costs included in the Contractor's bid associated with the original item to be substituted;
 - 2. All costs for material, equipment, labor associated with the proposed substitution, including any impact costs;
 - 3. Proposed change to the Contract Price and/or Contract Time; and
 - 4. Compatibility with or modification to other systems, parts, equipment or components of the Project and Contract Work.
- C. Contractor shall provide all documentation supporting its request as requested by City.
- D. All costs of any redesign or modification to other systems, parts, equipment or components of the Project or Contract Work, which result from the substitution, shall be borne by the Contractor.
- E. When City approves a substitution proposed by the Contractor, the Contractor shall guarantee the substituted article or materials to be equal to, or better than, those originally specified and shall be compatible with all other systems, parts, equipment or components of the Project and Contract Work. City has the right to order an unaccepted, substituted article removed and replaced without additional cost to City.

- F. City has a right to a deductive Change Order if the substituted product or process is less costly than the contractually required product or process.
- G. If City does not accept the substitution proposal the Contractor shall proceed, without delay or cost to City, with the Contract Work as originally specified.

4.10 INCREASED OR DECREASED QUANTITIES

- A. Payment to the Contractor will be made only for the actual quantities of work performed and accepted in conformance with the contract. When the accepted quantity of work performed under a unit item varies from the original proposal quantity, payment will be at the unit contract price for all work unless the total accepted quantity of any contract item, adjusted to exclude added or deleted amounts included in change orders accepted by both parties, increases or decreases by more than 25 percent from the original proposal quantity. In that case, payment for contract work may be adjusted as described herein:
 - 1. The adjusted final quantity shall be determined by starting with the final accepted quantity measured after all work under an item has been completed. From this amount, subtract any quantities included in additive change orders accepted by both parties. Then, to the resulting amount, add any quantities included in deductive change orders accepted by both parties. The final result of this calculation shall become the adjusted final quantity and the basis for comparison to the original proposal quantity.
 - a. Increased Quantities: Either party to the contract will be entitled to renegotiate the price for that portion of the adjusted final quantity in excess of 1.25 times the original proposal quantity. The price for excessive quantities will be determined by agreement of the parties, or, where the parties cannot agree, the price will be determined by the City based upon the actual costs to perform the work, including markup for overhead and profit in accordance with Paragraph 6.3, *Allowable Costs*.
 - b. Decreased Quantities: Either party to the contract will be entitled to an equitable adjustment if the adjusted final quantity of work performed is less than 75 percent of the original bid quantity. The equitable adjustment shall be based upon and limited to three factors:
 - i. Any increase or decrease in unit costs of labor, materials or equipment, utilized for work actually performed, resulting solely from the reduction in quantity;
 - ii. Changes in production rates or methods of performing work actually done to the extent that the nature of the work actually performed differs from the nature of the work included in the original plan; and
 - iii. An adjustment for the anticipated contribution to unavoidable fixed cost and overhead from the units representing the difference between the adjusted final quantity and 75% of the original plan quantity.
- B. The following limitations shall apply to renegotiated prices for increases and/or equitable adjustments for decreases:
 - 1. Labor, materials and equipment rates shall be actual costs but shall not exceed the rates set forth in Paragraph 6.3, *Allowable Costs* nor shall overhead and profit exceed the rates set forth in Paragraph 6.3, *Allowable Costs*.

2. No payment for consequential damages or loss of anticipated profits will be allowed because of any variance in quantities from those originally shown in the proposal form, contract provisions, and contract plans.
 3. The total payment (including the adjustment amount and unit prices for work performed) for any item which experiences an equitable adjustment for decreased quantity shall not exceed 75% of the amount original bid for the item.
- C. If the adjusted final quantity of any item does not vary from the quantity shown in the proposal by more than 25% then the Contractor and the City agree that all work under that item will be performed at the original contract unit price and within the original time for completion.
 - D. When ordered by the Engineer, the Contractor shall proceed with the work pending determination of the cost or time adjustment for the variation in quantities.
 - E. The Contractor and the City agree that there will be no cost adjustment for decreases if the City has entered the amount for the item in the proposal form only to provide a common proposal for bidders.

ARTICLE 5: CHANGES TO THE CONTRACT

5.1 GENERAL

- A. No provisions of the Contract may be amended or modified except by written agreement signed by the City.
- B. All Change Order work shall be performed in accordance with the original Contract requirements unless modified in writing by City.
- C. Any response to a Request For Information, or other directive, direction, instruction, interpretation, or determination (hereinafter referred to as "Direction" for the purposes of Article 5), provided by City is not considered a Change Order, a change to Contract requirements, and shall not constitute, in and of itself, entitlement to an adjustment in Contract Price and/or Contract Time.
- D. The Contractor shall not be entitled to any change in the Contract Price and/or Contract Time under the following conditions or events:
 1. They were reasonably foreseeable at the time the Contractor submitted its bid;
 2. They were caused by the acts of the Contractor, Subcontractor and/or Supplier, including but not limited to the choice of means, methods, techniques, sequences, or procedures for the Work, failure to provide labor, materials or equipment in a timely manner, and failure to take reasonable steps to mitigate delays, disruptions, or conditions encountered.
- E. The Contract requirements for time and price impacts related to Change Orders are set forth in Article 6, *Time and Price Adjustments*.
- F. If there is a bid item for "Minor Changes," payments or credits for changes that cost \$5,000 or less and do not affect time, may, at the discretion of the City, be made under that bid item in lieu of the procedures set forth in Sections 5.1 – 5.6. A Minor Change will be documented by a written Order for a Minor Change or by a notation confirming an oral agreement.

5.2 CONTRACTOR'S REQUEST FOR A CHANGE ORDER

- A. Notice of Claim and Supplemental Information. If the Contractor believes that it is entitled to additional compensation and/or time for any reason (other than for a differing site condition under Section 5.2), or if the Contractor disagrees with any written or oral direction, instruction, interpretation or determination from the City, the Contractor shall
- (1) Provide the Engineer with a written Notice of Protest before doing any work or incurring any costs for which it may seek additional compensation or time from the City.
 - (2) Supplement the written Notice of Protest within 14 days with a written statement that includes the following:
 - a. The date, circumstances, and basis of entitlement to additional compensation and/or time;
 - b. The estimated dollar cost of the protested work and a detailed breakdown showing how that estimate was determined;
 - c. An analysis of the progress schedule showing the schedule change or disruption if the Contractor is asserting a schedule change or disruption;
 - d. Substantive basis of the Request;
 - e. If the protest is continuing, the information required above shall be supplemented upon request by the Engineer until the protest is resolved; and
 - f. The Contractor waives all claims for additional compensation and time if it fails to provide both a timely Notice of Claim and Supplemental Information with the information required by this Section.
- B. Request for Change Order.
1. A Request for a Change Order must be submitted in writing to the Engineer no later than thirty-five (35) days after the Contractor submitted its supplemental information pursuant to Paragraph 5.1(A)(2).
 2. The Request for a Change Order shall include:
 - a. Specific dollar amount covering all costs associated calculated in accordance with Article 6, *Time and Price Adjustments*;
 - b. Specific request for time extension (number of days) calculated in accordance with Article 6, *Time and Price Adjustments*;
 - c. A copy of the written Notice of intent, including all attachments;
 - d. All documentation supporting the Request for a Change Order, including but not limited to a cost proposal prepared using the forms provided by City, all cost records, schedule analysis, and the documents identified in §00700, ¶3.10, *Maintenance and Inspection of Documents*, that are in any way relevant to the Contractor's Request for Change Order; and
 - e. The Contractor waives all claims for additional compensation and time if it fails to provide a timely Request for Change Order with the information required by this Section.
- C. City's Response to Contractor's Request for Change Order.

1. City will make a written determination with respect to the Contractor's Request for Change Order within thirty (30) days of receipt of said Request, unless one of the following activities occurs.
 - a. City may request additional information and specify a time period for receipt of the information. The Contractor shall comply with City's request for additional information.
 - b. City may inform the Contractor that additional time is needed to review the Contractor's Request for Change Order and identify a date certain when a decision will be rendered.
 2. If City requests additional information, City will make a written determination within thirty (30) days receipt of Contractor's additional information.
 3. If City does not make a determination within the applicable time period, the Request For Change Order is deemed denied.
- D. Approval of Request for Change Order and Execution of Change Order. If City determines that a Change Order is necessary, the parties may negotiate acceptable terms and conditions and execute a Bilateral Change Order or City may issue a Unilateral Change Order.
- E. Contractor Procedure upon Denial or Deemed Denial of a Request for a Change Order. If the Contractor disagrees with the denial, the Contractor's sole remedy shall be to file a fully documented Claim within thirty (30) days of deemed denial or the Contractor's receipt of the denial in accordance with Article 9, *Claims and Litigation*.
- F. Contractor's Obligation to Continue to Work. Pending resolution of the Contractor's Request for a Change Order, the Contractor shall continue to perform all Work including, at the written request of City that work associated with the pending Request for Change Order. The Contractor shall maintain its progress with the Work.
- G. Waiver. Failure to follow the provisions set forth herein shall constitute a waiver of the Contractor's right to receive any additional time or money as a result of any alleged direction, instruction, interpretation, determination by City and/or the event or impact to the Project.

5.3 DIFFERING SITE CONDITIONS

- A. Immediate Written Notice to City. If the Contractor encounters a Differing Site Condition as defined in Article 1.0 the Contractor shall immediately, and before the conditions are disturbed, give written Notice to City of Differing Site Conditions.
- B. Request for Change Order based on Differing Site Condition. Unless otherwise agreed upon in writing by the Engineer, within forty-five (45) days of the Contractor's initial written notification of the Differing Site Condition to City, the Contractor shall provide a Request for Change Order that includes all elements required for such a request, including:
 1. A detailed description of the Differing Site Condition; and
 2. Substantive, contractual, and technical basis supporting the existence of the Differing Site Condition and its impacts.
- C. Waiver.

1. If the Contractor's actions disturb the Site such that City or City's designee cannot adequately and fully investigate the alleged differing site condition, the Contractor waives its right to receive any additional time or money as a result of the Differing Site Condition.
 2. Failure by the Contractor to provide either (a) immediate Notice or (b) Request for Change Order shall constitute a waiver of the Contractor's right to receive any additional time or money as a result of the Differing Site Condition.
 3. The Contractor shall be responsible for any and all costs or damages incurred by City resulting from the Contractor's failure to provide appropriate notice and/or the Detailed Description and Request for Change Order.
- D. City's Response to the Differing Site Condition Request for Change Order. City shall investigate the alleged Differing Site Conditions and respond to the Differing Site Condition in accordance with the Request for Change Order procedures set forth above.
- E. Contractor's Obligation to Continue to Work. The Contractor shall not disturb the condition until receipt of written authorization from the Engineer that work can resume at the location of the alleged Differing Site Condition. The Contractor shall continue with performance of all other Work.

5.4 SUSPENSION OF WORK

A. City Issues Directive Suspending Work

1. City may order the Contractor, in writing, to suspend all or any part of the Work of this Contract for the period of time that City determines appropriate for the convenience of City. The Contractor shall not suspend the Work without written direction from City specifically authorizing the Suspension of Work.
2. Upon receipt of a written Notice suspending the Work, the Contractor shall immediately comply with its terms and take all reasonable steps to minimize costs attributable to such suspension. Within a period up to 120 days after the suspension notice is received by the Contractor, or within any extension of that period which City requires, City shall either:
 - a. Cancel the written notice suspending the Work; or
 - b. Terminate the Work for either default or convenience.
3. If a written notice suspending the Work is canceled or the period of the Suspension or any extension thereof expires, the Contractor shall resume Work as required by City.
4. If the performance of all or any part of the Work is, for an unreasonable period of time, suspended by the written direction of City, the Contractor may be entitled to an adjustment in the Contract Time, or Contract Price, or both, for increases in the time or cost of performance directly attributable to the suspension and provided that the Contractor sufficiently documents all costs and time impacts attributable to the suspension. No adjustments to Contract Price and/or Contract Time shall be allowed unless the Contractor can demonstrate that the period of suspension caused by City impacted Critical Path and delayed the Contractor from completing the Work on time.

B. Constructive Suspension of Work

1. If the Contractor believes that some action or omission on the part of City constitutes constructive suspension of Work, the Contractor shall immediately notify City in writing that the Contractor considers the actions or omission a constructive suspension of Work.
- C. To the extent the Contractor believes it is entitled to any additional money or time as a result of the suspension of Work or constructive suspension, Contractor shall submit a Notice of Protest, Supplemental Information and Request for Change Order to City in accordance with Article 5, *Changes to the Contract*.
- D. Failure to comply with these requirements shall constitute a waiver of Contractor rights to any adjustment in Contract Time and/or Contract Price.
- E. No adjustment shall be made under this provision for any suspension to the extent that Contractor's performance would have been suspended, delayed, or interrupted as a result of actions, omissions, fault or negligence caused, in whole or in part, by the Contractor or any of its Subcontractors.

5.5 FORCE MAJEURE

- A. To the extent the Contractor believes it is entitled to any additional time as a result of Force Majeure, Contractor shall submit a Notice of Protest, Supplemental Information and Request for Change Order to City in accordance with Article 5, *Changes to the Contract*.
- B. Contractor shall not be entitled to a change in Contract Price resulting from an act of Force Majeure.
- C. Contractor is not entitled to an adjustment in Contract Time if the act of Force Majeure did not impact progress of the Work on the Critical Path and delay the Contractor from completing the Work within the Contract Time.
- D. When a Contractor experiences concurrent delay caused by either City or Contractor and an act of Force Majeure, the Contractor shall only be entitled to an change in Contract Time. No change to the Contract Price shall be allowed as a result of such concurrent delay.

5.6 CHANGE ORDERS

A. Bilateral Change Orders

1. If City and Contractor reach agreement on the terms and conditions of any change in the Work, including any adjustment in the Contract Price and Contract Time, such agreement shall be incorporated into a Change Order and signed by both Parties. Such Bilateral Change Orders shall represent full and complete payment and final settlement of all changes, Claims, damages or costs for all (a) time; (b) direct, indirect, and overhead costs; (c) profit; and (d) any and all costs or damages associated with delay, inconvenience, disruption of schedule, impact, ripple effect, loss of efficiency or productivity, acceleration of work, lost profits, stand-by, and any other costs or damages related to any work either covered or affected by the Change Order, or related to the events giving rise to the Bilateral Change Order.

B. Unilateral Change Order

1. City's Right to Issue Unilateral Change Order.

- a. City may unilaterally issue a Change Order at any time, without invalidating the Contract and without notice to the sureties, making changes within the general scope of this Contract.
- b. If any such Change Order causes an increase or decrease in the cost of, or time required for, performance of any part of the Work, City may make an adjustment in the Contract Price, Contract Time, or both, in accordance with Articles 5, *Changes to the Contract*, and 6, *Time and Price Adjustments*.

2. Contractor Disagreement with Unilateral Change Order. If the Contractor disagrees with the adjustment to the Contract Price and/or Time as indicated in the Unilateral Change Order, the Contractor must submit a Notice of Protest, Supplemental Information and Request for Change Order to City in accordance with Article 5, *Changes to the Contract*.

3. Contractor's Obligation to Continue to Work. The Contractor is required to continue with performance of all Work, including work associated with the Unilateral Change Order.

5.7 CITY REQUEST FOR A CHANGE PROPOSAL

A. Request. City may request a written Change Proposal from the Contractor for a change in the Work.

B. Contractor's Proposal. Contractor shall submit its written Change Proposal within the time specified in City's request with the costs shown in a form acceptable to the City. The Change Proposal shall represent the Contractor's offer to perform the requested work, and the pricing set forth within the proposal shall represent full, complete, and final compensation for the proposed change and any impacts to any other Work, including any adjustments in the Contract Time.

C. City's Acceptance of Contractor Proposal. If City accepts the Change Proposal as submitted by the Contractor or as negotiated by the parties, City shall notify the Contractor in writing of its acceptance of the Proposal and direct that the change in the Work be performed.

D. Execution of a Bilateral Change Order. After acceptance of the Change Proposal or acceptance of the negotiated Change Proposal, City shall direct the Contractor to perform the work in accordance with the agreed upon terms; thereafter, the Parties shall execute a bilateral Change Order in accordance with the terms of the Change Proposal or negotiated Change Proposal.

E. Execution of Unilateral Change Order. If City does not accept the Change Proposal or the Parties cannot agree upon the appropriate price or terms for the Change Proposal, City may issue a unilateral Change Order.

ARTICLE 6: TIME AND PRICE ADJUSTMENTS

6.1 CHANGE IN THE CONTRACT TIME

A. The Contract Time shall only be changed by a Change Order.

- B. No change in the Contract Time shall be allowed to the extent the time of performance is changed due to the fault, act, or omission of Contractor, or anyone for whose acts or omissions the Contractor is responsible.
- C. Contractor is not entitled to a change in Contract Time unless the progress of the Work on the Critical Path is delayed and completion of the Contract Work within Contract Time is delayed.
- D. When a Contractor experiences concurrent delays which impact the Critical Path and are caused by (1) City and the Contractor; (2) City and an act of Force Majeure; or, (3) the Contractor and an act of Force Majeure, the Contractor shall only be entitled to a change in Contract Time. No change to the Contract Price shall be allowed as a result of such concurrent delay.
- E. A Request for Change Order that includes a request for an adjustment in the Contract Time shall:
 - 1. Be in writing and delivered to City within the appropriate time period specified in Article 5, *Changes in the Contract*.
 - 2. Include a clear explanation of how the event or conditions specifically impacted the Critical Path and overall Project Schedule and the amount of the adjustment in Contract Time requested.
 - 3. Be limited to the change in the Critical Path of a Contractor's Project Schedule, and any updates, attributable to the event or conditions, which caused the request for adjustment. No extension of time or compensation for damages resulting from delay will be granted unless the delay affects the timely completion of all Work under the Contract or timely completion of a portion of the Work for which time of completion is specific. Contractor shall be responsible for showing clearly on the Project Schedule, and any updates, that the event or conditions:
 - a. Had a specific impact on the Critical Path and was the sole cause of such impact;
 - b. Could not have been avoided by resequencing of the Work or other reasonable alternatives; and
 - c. Will prevent the Contractor from completing the Project within the current Contract completion date.
- F. Contractor shall make all reasonable efforts to prevent and mitigate the effects of any delay, whether occasioned by an act of Force Majeure or otherwise.

6.2 CHANGE IN THE CONTRACT PRICE

- A. The Contract Price shall only be changed by a Change Order.
- B. No change in the Contract Price shall be allowed when:
 - 1. Contractor's changed cost of performance is due to the fault, acts, or omissions of Contractor, or anyone for whose acts or omissions Contractor is responsible, including its subcontractors and suppliers;
 - 2. The change is concurrently caused by Contractor and City; or
 - 3. The change is caused by an act of a third party or Force Majeure.

- C. City shall not be responsible for, and the Contractor shall not be entitled to any compensation for unallowable costs. Unallowable costs include, but are not limited to:
1. Interest or attorney's fees of any type other than those mandated by Washington state statute;
 2. Claim preparation or filing costs;
 3. The cost of preparing or reviewing Change Proposals or Requests for Change Orders;
 4. Lost profits, lost income or earnings;
 5. Costs for idle equipment when such equipment is not at the Site, has not been employed in the Work, or is not scheduled to be used at the Site;
 6. Lost earnings or interest on unpaid retainage;
 7. Claims consulting costs;
 8. The costs of corporate officers or staff visiting the Site or participating in meetings with City;
 9. Loss of other business; and/or
 10. Any other special, consequential, or incidental damages incurred by the Contractor, Subcontractor, or Suppliers.
- D. A Request for Change Order that includes a request for an adjustment in Contract Price shall:
1. Be in writing and delivered to City within the applicable time period specified in Article 5, *Changes to the Contract*.
 2. Identify the following information:
 - a. The event or condition which caused the Contractor to submit its request for an adjustment in the Contract Price;
 - b. The nature of the impacts to Contractor and its Subcontractors, if any; and
 - c. The amount of the adjustment in Contract Price requested calculated in accordance with Paragraph 6.3, *Allowable Costs*, and using forms provided by City.
 3. Any requests by Contractor for an adjustment in the Contract Price and in the Contract Time that arise out of the same event or conditions shall be submitted together.
- E. The adjustments to the Contract Price provided for in this Article represent full, final, and complete compensation for all work done in connection with the request for an adjustment in Contract Price and all costs related to, resulting from, or affected by such change in Work including, but not limited to, all direct and indirect costs, overhead, profit, and all costs or damages associated with delay, inconvenience, disruption of schedule, impact, dilution of supervision, inefficiency, ripple effect, loss of efficiency or productivity, acceleration of work, lost profits, and any other costs or damages related to any work either covered or affected by the change in the Work, or related to the events giving rise to the change.

6.3 METHOD TO CALCULATE ADJUSTMENTS TO CONTRACT PRICE

- A. One of the following methods shall be used to calculate damages and/or adjustments to the Contract Price that result from or relate to Change Proposal, Request for Change Order, and/or Claim.
- B. Determination of the method to be used to calculate adjustments in the Contract Price shall be at the sole discretion of City.
- C. One of the following methods shall be used:
 - 1. Unit Price Method;
 - 2. Firm Fixed Price Method (also known as Lump Sum); or
 - 3. Time and Materials Method.
- D. **Unit Price Method**
 - 1. The City may direct the Contractor to perform extra work on a Unit Price basis. Such authorization shall clearly state the:
 - a. Scope of work to be performed;
 - b. Applicable Unit Price; and
 - c. Not to exceed amount of reimbursement as established by City.
 - 2. The applicable unit price shall include reimbursement for all direct and indirect costs of the work, including Overhead and profit, as limited by paragraph 6.3, *Allowable Costs*.
 - 3. Contractor shall only be paid under this method for the actual quantity of materials incorporated in or removed from the Work and such quantities must be supported by field measurement statements verified by City.
- E. **Firm Fixed Price Method**
 - 1. The Contractor and City may mutually agree on a fixed amount as the total compensation for the performance of changed work.
 - 2. The Contractor shall provide a detailed cost breakdown supporting the Contractor's requested adjustment to Contract Price and any other financial documentation requested by the Engineer, as limited by paragraph 6.3, *Allowable Costs*.
 - 3. Any adjustments to the Contract Price using the Firm Fixed Price Method shall include, when appropriate all reasonable costs for labor, equipment, material, Overhead and profit. Such labor, equipment, material, Overhead and profit shall be calculated in accordance with paragraph 6.3, *Allowable Costs*.
 - 4. Whenever City authorizes Contractor to perform changed work on a Firm Fixed Price Method, City's authorization shall clearly state:
 - a. Scope of work to be performed; and
 - b. Total Fixed Price payment for performing such work.
- F. **Time and Materials Method**
 - 1. Whenever City authorizes the Contractor to perform work on a Time and Material basis, City's authorization shall clearly state:

- a. Scope of work to be performed; and
 - b. A not to exceed amount of reimbursement as established by City.
2. Contractor shall:
- a. Cooperate with City and assist in monitoring the work being performed;
 - b. Substantiate the labor hours, materials and equipment charged to work under the Time and Materials Method by detailed time cards or logs completed on a daily basis before the close of business each working day;
 - c. Present the time card and/or log at the close of business each day to the Engineer so that City may review and initial each time card/log;
 - d. Perform all work in accordance with this provision as efficiently as possible;
 - e. Not exceed any cost limit(s) without City's prior written approval; and
 - f. Maintain all records of the work, including all records of the Subcontractor, Supplier, and Materialmen, and make such records available for inspection as required in paragraphs 3.8, *Record Documents*, 3.9, *Cost Records*, and 3.10, *Maintenance and Inspection of Document*.
3. Contractor shall submit costs and any additional information requested by City to support Contractor's requested price adjustment.
4. The Contractor shall only be entitled to be paid for reasonable costs actually incurred by the Contractor. The Contractor has a duty to control costs. If City determines that the Contractor's costs are excessive or unreasonable, City, at its discretion, shall determine the reasonable amount for payment.

G. Deductive Changes to the Contract Price

1. A deductive change to the Contract Price may be determined by taking into account:
- a. Costs incurred and saved by the Contractor as a result of the change, if any;
 - b. The costs of labor, material, equipment, and overhead saved and profit unearned by the deleted work. These costs shall be calculated following as closely as possible with the provisions identified in Article 6, Time and Price Adjustments; and/or,
 - c. At the discretion of City, costs set forth in the documents used by the Contractor to develop its bid.
2. Where City has elected not to correct incomplete or defective Work, the adjustment in the Contract Price shall take into account:
- a. The costs the City would have to expend to correct the Work;
 - b. The decreased value to City resulting from the incomplete or defective Work; and,
 - c. The increased future costs which City may incur by reason of the incomplete or defective Work.

H. Full Compensation

An adjustment calculated in accordance with the provisions of this Article shall be full and complete payment and final settlement of all changes, claims, damages and costs for all (a) time; (b) direct, indirect, and overhead costs; (c) profit; and (d) any and all costs or damages associated with delay, inconvenience, disruption of schedule, impact, ripple effect, loss of efficiency or productivity, acceleration of work, lost profits, standby, and/or any other costs or damages related to any Work either covered or affected by the changed Work, or related to the events giving rise to the change.

6.4 ALLOWABLE COSTS

- A. Any adjustments to the Contract Price shall be based on the following categories and shall incorporate markups for Overhead and profit as provided herein.
1. **Labor.** For all labor, including foreman supervision but excluding superintendents and other project management and consultants, the Contractor shall be reimbursed for labor costs provided herein. The labor cost of an event or condition shall be calculated as the sum of the following:
 - a. **Labor Rate.** The Labor Rate is the actual reasonable wage paid to the individual plus the actual reasonable costs incurred by the Contractor to cover costs associated with Federal Insurance Compensation Act (FICA), Federal Unemployment Tax Act (FUTA), State Unemployment Tax Act (SUCA), industrial insurance, fringe benefits, and benefits paid on behalf of labor by the Contractor. The applicable Labor Rates shall be multiplied by the number of hours reasonably expended in each labor classification because of the event or condition to arrive at a total cost of labor.
 - b. **Travel Allowance and/or Subsistence.** The labor calculation shall include the actual costs of travel and/or subsistence paid to the Contractor's employees engaged upon the Work when said payments are required by a labor agreement.
 2. **Materials.** The cost of materials resulting from an event or condition shall be calculated in one or more of the following methods, at City's election:
 - a. **Invoice Cost.** The Contractor may be paid the actual invoice cost of materials including actual freight and express charges and applicable taxes less all available discounts, rebates, and back-charges,. This method shall be considered only to the extent the Contractor's invoice costs are reasonable and the Contractor provides copies of vendor invoices, freight and express bills, and other evidence of cost accounting and payment satisfactory to City. As to materials furnished from the Contractor's stocks for which an invoice is not available, the Contractor shall furnish an affidavit certifying its actual cost of such materials and such other information as City may reasonably require;
 - b. **Wholesale Price.** The Contractor may be paid the lowest current wholesale price for which the materials are available in the quantities required, including customary costs of delivery and all applicable taxes less all available discounts, rebates, and back-charges; or

- c. **City Furnished Material.** City reserves the right to furnish such materials as it deems advisable, and the Contractor shall have no Claim for any costs, Overhead or profit on such materials. However, should the Contractor be required to pick up, transport and/or unload such materials the Contractor will be reimbursed for reasonable costs thereof.
- 3. **Equipment.** The additional cost, if any, of machine-power tools and equipment usage shall be calculated in accordance with the following rules:
 - a. **Equipment Rates.** The Contractor's own charge rates may be used if verified and approved by City and based on the Contractor's actual ownership and operating cost experience. Rental rates contained in published rate guides may be used if their cost formulas and rate factors are identifiable, reflect the Contractor's historical acquisition costs, utilization, and useful life, and do not include replacement cost, escalation contingency reserves, general and administrative expense, or profit. Rates shall be based on the Contractor's actual allowable costs incurred or the rates established according to the Rental Rate Blue Book for Construction Equipment, published by Equipment Watch, PRIMEDIA, whichever is less. The Rental Rate Blue Book established hourly equipment rate shall be the monthly rental rate for the equipment plus the monthly rental rate for required attachments, divided by 176 work hours per month, multiplied by the appropriate regional adjustment factor, plus the hourly operating cost. The established equipment rate shall apply for actual equipment usage up to eight hours per day. For all hours in excess of eight hours per day or 176 hours per month, the established equipment rate shall be the monthly rental rate plus the monthly rental rate for required attachments, divided by 352, multiplied by the regional adjustment factor, plus the hourly operating cost.
 - b. **Transportation.** If the necessary equipment is not already at the Site and it is not anticipated that it would be required for the performance of other work under the terms of the Contract, the calculation shall include a reasonable amount for the costs of the necessary transportation of such equipment.
 - c. **Standby.** The Contractor shall only be entitled to standby equipment costs if (a) the equipment is ready, able, and available to do the Work at a moment's notice; (b) Contractor is required to have equipment standby because of an event or condition solely caused by City and (c) the Contractor can demonstrate that it could have and intended to use the equipment on other projects/jobs. The Contractor shall be compensated at 50% of the monthly rental rate for the equipment, divided by 176, and multiplied by the appropriate regional adjustment factor, as identified in the Rental Rate Blue Book for Construction Equipment, published by Machinery Information Division of PRIMEDIA Information Inc. Standby shall not be paid during periods of Contractor-caused delay, concurrent delay, Force Majeure, during any seasonal shutdown, routine maintenance, down-time or broken equipment, late delivery of equipment or supplies, or other anticipated occurrence specified in the Contract Documents. No payment shall be made for standby on any piece of equipment, which has been used on the Project in any 24 hour period. Standby costs shall not be paid for weekends, holidays, and any time the equipment was not intended to be used on the Project as demonstrated by the Project Schedule.

4. **Subcontractor & Supplier.** Direct costs associated with Subcontractors and Suppliers shall exclude Overhead and Profit markups and shall be calculated and itemized in the same manner as prescribed herein for Contractor. Contractor shall provide detailed breakdown of Subcontractor and Supplier invoices.
5. **Overhead and Profit Markup.**
 - a. On a change to the Contract Price or any other claim for money by the Contractor, City will only pay Overhead, including Home Office Overhead, Site or Field Office Overhead, and unabsorbed home office overhead, and Profit pursuant to the Overhead and Profit Markups set forth herein. The Overhead and Profit Markups cover all overhead regardless of how the Contractor chooses to account for various costs in its books of account.
 - b. Overhead and Profit markups shall not be applied to freight, delivery charges, express charges, and sales tax.
 - c. The allowed Overhead and Profit markup shall not exceed the following:
 - i. If the Contractor is self-performing work: 18% combined Overhead and Profit markup on the Contractor's Direct Costs;
 - ii. If a Subcontractor or Supplier is performing work: 18% for the Subcontractor's Direct Cost for performing the work and 7% on the Direct Costs of the Subcontractors' or Suppliers'; provided that the 7% is to be divided among upper tier Subcontractors and the Contractor when a Subcontractor or Supplier is performing the work;
 - iii. If the value of material and equipment is greater than 50% of the total value of the change, the Overhead and Profit Markup shall only be 10% for material and equipment; and
 - iv. In no event shall the total combined Overhead and Profit markup for the Contractor and all Subcontractors and Suppliers of any tier exceed 25% of the Direct Cost to perform the Change Order work.

ARTICLE 7: PAYMENT AND COMPLETION

7.1 APPLICATIONS FOR PAYMENT

- A. On or about the first day of each month, the Contractor shall submit to City an Application for Payment. Each application shall be completed on a form acceptable to City and designated as an "Application for Payment."
- B. The Contractor is not entitled to payment for any work unless the Application for Payment includes all required documentation. City reserves the right to withhold payment pursuant to paragraph 7.2, *Payments Withheld* if it is subsequently determined that all required documentation was not provided by the Contractor or is in error.
- C. The application shall correlate the amount requested with the Schedule of Values and with the state of completion of the Work.
- D. The Contractor shall submit a breakdown of the cost of lump sum items to enable the Engineer to determine the Work performed on a monthly basis. Lump sum breakdowns shall be submitted prior to the first progress payment that includes

payment for the Bid Item. Absent a lump sum breakdown, the Engineer will make a determination based on information available.

7.2 PAYMENTS

- A. City shall comply with RCW 39.76, as amended, and promptly review each Application for Payment and identify in writing any cause for disapproval within 8 working days. In addition to withholding payment for unsatisfactory performance or failure to comply with Contract requirements, if the Contractor's Application for Payment fails to recognize any back-charges, off-sets, credits, change orders, or deductions in payment made in accordance with paragraph 7.2, *Payments Withheld*, City shall have the right to revise or disapprove Contractor's Application For Payment because the Application for Payment is not considered a properly completed invoice.
- B. The City shall withhold retainage from each Application for Payment as required by RCW 60.28, as amended.
- C. If an Application for Payment is accepted by City, it shall be paid within thirty (30) days of City's receipt of the properly prepared invoice (Application for Payment).

7.3 PAYMENT WITHHELD

- A. In addition to retainage withheld pursuant to RCW 60.28 and without waiver of any other available remedies, City has the right to withhold, nullify, or back-charge, in whole or in part, any payment or payments due or that have been paid to the Contractor as may be necessary to cover City's costs or to protect City from loss or damage for reasons including but not limited to:
 - 1. Failure of the Contractor to submit or obtain acceptance of a Progress Schedule, Schedule of Values, and any updated Schedules;
 - 2. Defective or non-conforming Work;
 - 3. Costs incurred by City to correct, repair or replace defective or non-conforming Work, or to complete the Work;
 - 4. A reasonable doubt that the Contract can be completed for the balance then unpaid;
 - 5. A reasonable concern by City that the materials, equipment or component parts are not in proper operating condition;
 - 6. Assessment of Liquidated Damages;
 - 7. Failure to perform in accordance with the Contract;
 - 8. Cost or liability that may occur to City as the result of the Contractor's or Subcontractor's acts, omissions, fault, or negligence;
 - 9. Deduction in the Work;
 - 10. Failure of Contractor to repair damaged materials, equipment, property, or Work;
 - 11. Failure of the Contractor to obtain approval of Submittals pertinent to the work accomplished;
 - 12. Failure to pay Subcontractors, Suppliers, employees or other obligations arising out of the Work;

13. Failure to keep Record Documents up to date;
 14. Failure to comply with all applicable federal, state, and local laws, statutes, regulations, codes, licenses, easements, and permits;
 15. Failure to obtain and maintain applicable permits, insurance, and bonds; and
 16. Failure to provide Statement of intent to Pay Prevailing Wage and/or Affidavits of Wages Paid and, if requested, Certified Payroll Records for the Contractor and for Subcontractors of any tier.
- B. The withholding, nullification, or back-charge of any payment(s) by City shall in no way relieve the Contractor of any of its obligations under this Contract.

7.4 TITLE

Title to all Work and materials covered by an accepted and paid Application For Payment shall pass to City at the time of such payment, free and clear of all liens, claims, security interest, and encumbrances. Passage of title shall not, however, (1) relieve Contractor from any of its duties and responsibilities for the Work or materials, including protection thereof, (2) waive any rights of City to insist on full compliance by Contractor with the Contract requirements, or (3) constitute acceptance of the Work or materials.

7.5 SUBSTANTIAL COMPLETION

- A. When the Contractor has achieved Substantial Completion (as defined in Section 1 above), the Contractor shall give written Notice to City.
1. City shall promptly inspect the Work and prepare a Punch List (list of items to be completed or corrected).
 - a. City reserves the right to add to, modify, or change the Punch List.
 - b. Failure by City to include any items on such list does not alter the responsibility of the Contractor to complete or correct the Work in accordance with the Contract.
- B. At the Contractor's request, City may identify those Punch List items that must be completed or corrected in order for the Contractor to achieve Substantial Completion.
1. When City determines that those Punch List items have been completed or corrected by the Contractor, City shall make a determination that the Work is Substantially Complete.
 2. A Certificate of Substantial Completion will be issued by City, which shall establish the date of Substantial Completion.
 3. This Certificate of Substantial Completion shall state the responsibilities of City and the Contractor for security, maintenance, heat, utilities, damage to the Work, and insurance.
- C. City shall assess liquidated damages for the Contractor's failure to Substantially Complete the Work within the Contract Time. The liquidated damage amounts, set forth elsewhere in the Contract Documents, will be assessed for Contractor's failure to achieve Substantial Completion within the Contract Time. These Liquidated Damages are not a penalty, but will be assessed against the Contractor for failure to achieve these Contract requirements. These Liquidated Damage amounts are

fixed and agreed upon by and between the Contractor and City because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages City would in such events sustain. These amounts shall be construed as the actual amount of damages sustained by City, and may be retained by City and deducted from payments to the Contractor. Assessment of Liquidated Damages shall not release the Contractor from any further obligations or duties pursuant to the Work.

- D. As provided in the Contract Documents, City may grant Substantial Completion to specific subsystems or portions of the Work. The dates of Substantial Completion shall be determined, in writing, by City.

7.6 FINAL INSPECTION

- A. The Contractor shall correct all remaining Punch List items and complete all remaining Work within the time period stated in the Certificate of Substantial Completion or within 30 days, whichever is less. When all Punch List items have been successfully corrected and the work is complete the Contractor's shall give written notice to the City that the Work ready for final inspection. After verification by City that such completion was satisfactory, the Contractor shall submit a Final Application for Payment.

7.7 REQUIREMENTS FOR FINAL APPLICATION FOR PAYMENT

- A. In addition to any other requirement identified in the Contract Documents, the Final Application for Payment shall include the following documents:
 - 1. Affidavit of Wages Paid for Contractor and all Subcontractors in accordance with state law;
 - 2. Contractor's release of claims against City, except for Claims specifically described in the release document and submitted in accordance with Article 9, *Claims and Litigation*; and
 - 3. Contractor certification that all Subcontractors and Suppliers have been paid and there are no outstanding liens.

7.8 COMPLETION/FINAL ACCEPTANCE

- A. Completion/Final Acceptance shall be achieved when all the obligations of the Contract have been successfully performed by the Contractor in accordance with the Contract and accepted by City. Should Contractor fail to achieve Final Acceptance within the required time the City may assess actual damages caused by its failure to do so.
- B. Neither Final Acceptance, nor Final Payment, shall release Contractor or its sureties from any obligations under this Contract or the Performance and Payment Bonds, or constitute a waiver of any claims by City arising from or related to Contractor's performance or failure to perform the Work and to meet all Contractual obligations in accordance with the Contract, including but not limited to:
 - 1. Unsettled liens, security interests or encumbrances;
 - 2. Damaged, non-conforming, or defective Work discovered by City;
 - 3. Terms of any warranties or guarantees required by the Contract; and
 - 4. Payments made in error.

- C. Except for any Claims properly submitted in accordance with Article 9, *Claims and Litigation*, acceptance of Payment on the Final Application for Payment by the Contractor shall, on behalf of itself and its Subcontractors or Sureties, forever and unconditionally release and discharge City, its officers, agents, employees, from:
 - 1. Any and all disputes or claims, including but not limited to claims for damages, fines, interest, taxes, attorney fees, or costs, demands, rights, actions or causes of actions, known or unknown, arising out of or in any way related to the parties' performance under the Contract and/or Project; and
 - 2. Any and all known and/or unknown liabilities, obligations, demands, actions, suits, debts, charges, causes of action, requests for money and/or payment under the Contract, outstanding invoices, or claims directly or indirectly arising out of or related to the Contract and/or Project.

7.9 WARRANTY AND GUARANTY

- A. In addition to any special warranties provided elsewhere in the Contract, Contractor warrants that all Work conforms to the requirements of the Contract and is free from any defect in equipment, material, design, or workmanship performed by Contractor or its Subcontractors and Suppliers.
- B. The warranty period shall be for the longer period of: one year from the date of Final Acceptance of the entire Project or the duration of any special extended warranty offered by a supplier or common to the trade.
- C. With respect to all warranties, express or implied, for Work performed or materials furnished according to the Contract, Contractor shall:
 - 1. Obtain all warranties that would be given in normal commercial practice from the supplier and/or manufacturer;
 - 2. Prior to Final Acceptance require all warranties be executed, in writing, for the benefit of City;
 - 3. Enforce all warranties for the benefit of City; and
 - 4. Be responsible to enforce any warranty of a Subcontractor, manufacturer, or Supplier, should they extend beyond the period specified in the Contract.
- D. If, within an applicable warranty period, any part of the Work is found not to conform to the Contract, the Contractor shall correct it promptly after receipt of written Notice from City to do so. In the event City determines that Contractor corrective action is not satisfactory and/or timely performed, then City has the right to either correct the problem itself or procure the necessary services, recommendations, or guidance from third parties. All damages incurred by City and all costs for City's remedy shall be reimbursed by the Contractor.
- E. The warranty provided in this provision shall be in addition to any other rights or remedies provided elsewhere in the Contract or by applicable law.

7.10 PRIOR OCCUPATION

City shall have the right to occupy such part or parts of the Project in or upon which the Work is being done, as it may see fit, and such occupation shall not be construed as acceptance by City of the Work or constitute Substantial Completion of the Work.

ARTICLE 8: TERMINATION

8.1 CITY'S RIGHT TO TERMINATE CONTRACT

A. Termination for Default

1. City may terminate, without prejudice to any right or remedy of City the Work, or any part of it, for cause upon the occurrence of any one or more of the following events:
 - a. Contractor fails to prosecute the Work or any portion thereof with sufficient diligence to ensure Substantial Completion of the Work within the Contract Time;
 - b. Contractor fails to prosecute the Work or any portion thereof with sufficient diligence to ensure Final Acceptance of the Work in a timely manner;
 - c. Contractor is adjudged bankrupt, makes a general assignment for the benefit of its creditors, or a receiver is appointed on account of its insolvency;
 - d. Contractor fails in a material way to repair, replace or correct Work not in conformance with the Contract;
 - e. Contractor repeatedly fails to supply skilled workers or proper materials or equipment;
 - f. Contractor repeatedly fails to make prompt payment to its employees or Subcontractors;
 - g. Contractor materially disregards or fails to comply with laws, ordinances, rules, regulations, permits, easements or orders of any public authority having jurisdiction;
 - h. Contractor fails to comply with all Contract safety requirements; or
 - i. Contractor is otherwise in material breach of any provision of the Contract, including but not limited to quality control, environmental requirements, administrative requirements, coordination and supervision.
2. If City reasonably believes that one of the aforementioned events has occurred, City will provide the Contractor with written Notice of its intent to terminate the Contractor for default, specifying within such notice the ground(s) for such termination. City, at its option, shall require the Contractor to either promptly correct the deficiencies noted in City's intent to terminate or provide City with a corrective action plan as to how such deficiencies will be remedied or cured in a timely fashion. However, if after receipt of the proposed remedy, City has a reasonable basis for concluding that the Contractor has (a) failed or is unwilling to repair, replace or correct the deficiencies, or (b) failed or is unwilling to provide a reasonable and satisfactory corrective action plan, City shall thereafter have the right to terminate this Contract for default.
3. Upon termination, City may at its option:
 - a. Take possession of the Site and possession of or use of all materials, equipment, tools, and construction equipment and machinery thereon owned by Contractor; and/or

- b. Finish the Work by whatever other reasonable method it deems expedient; or
 - c. Call upon the surety to perform its obligations under the performance and payment bonds, if applicable.
4. The Contractor and its sureties shall be liable for all damages and costs, including but not limited to: (1) compensation for architect and engineering services and expenses made necessary thereby; (2) any other costs or damages incurred by City in completing and/or correcting the Work; and (3) any other special, incidental or consequential damages incurred by City which results or arises from the breach or termination for default.
 5. In the event of termination for default City shall only pay the Contractor for Work successfully completed and accepted by City prior to the date of termination. City shall not be responsible for any other Contractor costs, expenses, or damages including any consequential, special, or incidental damages or lost profits associated with this Contract. In no event shall City reimburse the Contractor for any costs directly or indirectly related to the cause of this termination for default.
 6. If, after termination for default, it is determined that the Contractor was not in default, the rights and obligations of the parties will be the same as if the termination had been issued for the convenience of City.
 7. The rights and remedies of City in this provision are in addition to any other rights and remedies provided by law or under this contract.

B. Termination for Convenience

1. Upon written Notice City may terminate the Work, or any part of it, without prejudice to any right or remedy of City, for the convenience of City.
2. If City terminates the Work or any portion thereof for convenience, Contractor shall recover as its sole remedy:
 - a. Reasonable costs for all Work completed prior to the effective date of the termination and not previously paid for by City; and
 - b. A reasonable allowance for Overhead and profit for Work actually performed prior to the date of termination and accepted by City, at a rate not to exceed the percentage amount set forth in the Contract and in paragraph 6.3, *Allowable Costs*, subparagraph A.5, *Overhead and Profit*. The Contractor waives all other claims for payment and damages including without limitation, anticipated profit and overhead on work not performed and accepted by City.
3. The Contractor shall not be entitled to any other costs or damages, whatsoever. The total sum payable upon termination shall not exceed the Contract Price reduced by prior payments. Contractor shall be required to make its request for adjustment in accordance with Article 5, *Changes to the Contract*, and Article 6, *Time and Price Adjustments*.
4. If it appears that the Contractor would have sustained a loss on the entire Contract had it been completed, City shall not reimburse Contractor any profit for the Work completed and shall reduce the settlement to reflect the indicated rate of loss.

C. Contractor's Obligations During Termination

Unless City directs otherwise, after receipt of a written Notice of termination for default or termination for convenience, Contractor shall promptly:

1. Stop performing Work on the date and as specified in the Notice of termination;
2. Place no further orders or subcontracts for materials, equipment, services or facilities, except as may be necessary for completion of such portion of the Work not terminated;
3. Cancel all orders and subcontracts, upon terms acceptable to City, to the extent that they relate to the performance of Work terminated;
4. Assign as specifically requested by City all of the rights, title, and interest of Contractor in all orders and subcontracts;
5. Take such action as may be necessary or as directed by City to preserve and protect the Work, Site, and any other property related to this Project in the possession of Contractor in which City has an interest;
6. Continue performance of Work only to the extent not terminated; and
7. Take any other steps required by City with respect to this Project.

8.2 CITY'S RIGHT TO STOP THE WORK FOR CAUSE

- A. If Contractor fails or refuses to perform its obligations in accordance with the Contract, City may order Contractor, in writing, to stop the Work, or any portion thereof, until satisfactory corrective action has been taken.
- B. Contractor shall not be entitled to any adjustment in the Contract Time and/or Contract Price for any increased cost or time of performance attributable to Contractor's failure or refusal to perform its obligations under the Contract.

ARTICLE 9: CLAIMS AND LITIGATION

9.1 CONTRACTOR CLAIMS

A. Condition Precedent to Filing a Claim.

1. The following actions are a condition precedent to filing a Claim:
 - a. The Contractor submitted a timely Notice of Protest, Supplemental Information and Request for Change Order as required by paragraph 5.1;
 - b. The Request for Change Order has been denied or deemed denied by City;
or
 - c. A Unilateral Change Order is issued by City.

B. Failure to file a Timely Claim.

1. At least seven (7) days prior to appropriate time to file a Claim, the Contractor may request an extension of time for filing its Claim. The Contractor shall state the reasons for the request and identify a date certain when the Contractor shall provide a fully documented Claim. Unless otherwise agreed to in writing by the Engineer, a fully documented Claim shall be received by the City within thirty (30) days after:
 - a. Denial or deemed denial of a Request for Change Order; or

- b. Contractor's receipt of an Executed Unilateral Change Order.
- 2. Failure to comply with the time requirements set for filing a Claim shall constitute acceptance by the Contractor, on behalf of itself and its Subcontractors and Suppliers, of the Unilateral Change Order and/or City's denial or deemed denial of a Request for Change Order. Such acceptance shall be considered complete, full, and final settlement of all costs, damages, and Claims related to or arising from the Request for Change Order and/or Unilateral Change Order.
- C. Contractor's Obligation to Continue to Work. Pending final decision of a Claim hereunder, the Contractor shall proceed diligently with the performance of the Contract Work, including that work associated with the Claim, and maintain its progress with the Work.
- D. Information required in a Fully Documented Claim. Every Claim must be submitted by the Contractor, in writing and clearly designated by the Contractor as a fully documented Claim. At a minimum, a fully documented Claim must contain the following information:
 - 1. A detailed factual statement of the Claim providing all necessary details, locations, and items of Contract Work affected;
 - 2. The date on which facts arose that gave rise to the Claim;
 - 3. The name of each person employed or associated with the Contractor, Subcontractor, Supplier, and/or City with knowledge about the event or condition which gave rise to the Claim;
 - 4. Copies of documents and a written description of the substance of any oral communications that concern or relate to the Claim;
 - 5. The specific provisions of the Contract Documents on which the Claim is based;
 - 6. If an adjustment in the Contract Price is sought, the exact amount sought, calculated in accordance with the Contract including paragraph 6.3, *Allowable Cost* and accompanied by (a) all records supporting the Claim and (b) all records meeting the requirements of paragraph 3.10, *Cost Records*;
 - 7. If an adjustment in the Contract Time is sought, the specific days and dates for which it is sought; the specific reason the Contractor believes an adjustment in the Contract Time should be granted; and the Contractor's analyses of its Progress Schedule, any specific Schedule analysis as required by the Contract Documents, and all updates to demonstrate the reason for the adjustment in Contract Time; and
 - 8. A statement certifying, under penalty of perjury, that after the exercise or reasonable diligence and investigation the Claim is made in good faith, that the supporting cost and pricing data are true and accurate to the best of the Contractor's knowledge and belief, that the Claim is fully supported by the accompanying data, and that the amount requested accurately reflects the adjustment in the Contract Price or Contract Time for which the Contractor believes City is liable.
- E. Contractor's Duty to Cooperate. The Contractor shall cooperate with City or its designee in the evaluation of its Claim and provide all information and documentation requested by City, its auditors or its designee.

F. City's Evaluation of the Claim.

1. To assist City in the review of the Contractor's Claim, City or its designee may visit the Site, request additional information and/or documentation in order to fully evaluate the issues raised in the Claim and/or audit the Claim.
2. After the Contractor has submitted a fully documented Claim that complies with this provision, City shall respond, in writing, to the Contractor within sixty (60) days from the date the fully documented Claim is received with either:
 - a. A decision regarding the Claim; or
 - b. Written Notice extending for another thirty (30) days City's time to respond to the Claim.
3. Absent a thirty (30) day extension, the Claim shall be deemed denied upon the sixty-first (61st) day following receipt of the Claim by City. If City had a thirty (30) day extension, the Claim shall be deemed denied upon the ninety-first (91st) day following receipt of the Claim by City.

9.2 CONTRACTOR'S BURDEN OF PROOF ON CLAIM

- A. The Contractor shall have the burden of proof to demonstrate entitlement and damages.
- B. If the Contractor, on behalf of itself or its Subcontractors and Suppliers seeks an adjustment in the Contract Price or Contract Time not supported by Project cost records meeting the requirements of ¶3.10, *Cost Records*, the Claim is waived.
- C. Compliance with the record keeping requirements set forth in this Contract is a condition precedent to recovery of any costs or damages related to or arising from performance of the Contract Work. If City establishes non-compliance of the record-keeping requirement set forth in ¶ 3.10, *Cost Records*, no adjustment shall be made to the Contract Price and/or Contract Time with respect to that Claim.

9.3 LITIGATION

- A. As a mandatory condition precedent to the initiation of litigation by the Contractor against City, Contractor shall comply with all provisions set forth in this Contract including those stated in Article 5 and Article 9.
- B. Any litigation brought against City shall be filed and served on City within 365 days from either the issuance of the Certificate of Substantial Completion for the entire Contract or Final Acceptance if no Certificate of Substantial Completion of the entire Contract is issued.
- C. Venue and jurisdiction shall vest solely in the King County Superior Court.
- D. Failure to comply with these mandatory condition time requirements shall constitute a waiver of the Contractor's right to pursue judicial relief from or against the City.

ARTICLE 10: MISCELLANEOUS

10.1 COMPENSATION, WAGES, BENEFITS AND TAXES

City assumes no responsibility for the payment of any compensation, wages, benefits, or taxes owed by the Contractor by reason of this Contract. The Contractor shall indemnify and hold City, its elected officials, officers, agents and employees, harmless

against all liability and costs resulting from the Contractor's failure to pay any compensation, wages, benefits or taxes.

10.2 PREVAILING WAGES

The Contractor shall comply with the minimum wage requirements of RCW 39.12, as amended, including the obligation to pay at least the hourly minimum wage and fringe benefits to workers as required by RCW 39.12. The Contractor shall also post all notices required by the Washington Department of Labor & Industries on forms provided by the Department of Labor & Industries. The Contractor shall timely provide a "Statement of Intent to Pay Prevailing Wages" and timely provide an "Affidavit of Prevailing Wages Paid."

10.3 SUCCESSORS AND ASSIGNS

City and the Contractor each binds itself, its partners, successors, assigns and legal representatives to the other with respect to all covenants, agreements and obligations contained in the Contract. Neither party to 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 moneys due or to become due to it hereunder, without the previous written consent of City.

10.4 THIRD PARTY AGREEMENTS

Except as otherwise may be provided, the Contract shall not be construed to create a contractual relationship of any kind between: any architect, engineer, construction manager, Subcontractor, Supplier, or any persons other than City and Contractor.

10.5 NONWAIVER OF BREACH

No action or failure to act by City shall constitute a waiver of any right or duty afforded to City under the Contract; nor shall any such action or failure to act by City constitute an approval of or acquiescence in any breach hereunder, except as may be specifically stated by City in writing.

10.6 NOTICE TO CITY OF LABOR DISPUTES

- A. If Contractor has knowledge that any actual or potential labor dispute is delaying or threatens to delay timely performance in accordance with the Contract, Contractor shall immediately give Notice, including all relevant information, to City.
- B. Contractor agrees to insert a provision in its Subcontracts and to require insertion in all sub-subcontracts, that in the event timely performance of any such contract is delayed or threatened by any actual or potential labor dispute, all Subcontractor or lower-tiered Subcontractor shall immediately notify the next higher tier Subcontractor. Subcontractor or Contractor, as the case may be, of all relevant information concerning the dispute.

10.7 HEADINGS

The headings used in the Contract are for convenience only and shall not be considered a part of or affect the construction or interpretation of any contractual provision therein.

10.8 CHOICE OF LAW

In the event that either party shall bring a lawsuit or action related to or arising out of this Contract, such lawsuit or action shall be brought in the Superior Court, King County,

Washington. This Contract shall be governed by, and construed and enforced in accordance with the laws of the State of Washington.

10.9 SEVERABILITY

The provisions of this Contract shall be effective in all cases unless otherwise prohibited by Washington State Law or applicable Federal Law. The provisions of this Contract are separate and severable. The invalidity of any sentence, paragraph, provision, section, Article, or portion of this Contract shall not affect the validity of the remainder of this Contract.

SUPPLEMENTAL CONDITIONS

“Supplemental Conditions” contains portions of Division 1 of the 2020 Standard Specifications for Road, Bridge, and Municipal Construction, prepared by the Washington State Department of Transportation (WSDOT). Section 1-01 to Section 1-09 of Division 1 are deleted and replaced by the “General Terms and Conditions” included in this document. The entire content of Section 1-10 “Temporary Traffic Control” remains in effect, along with revisions and supplements provided within this Section.

1-05 CONTROL OF WORK

1-05.18 Record Drawings (March 8, 2013 APWA GSP)

The Contractor shall maintain one set of full-size plans for Record Drawings, updated with clear and accurate red-lined field revisions on a daily basis, and within 2 business days after receipt of information that a change in Work has occurred. The Contractor shall not conceal any work until the required information is recorded.

This Record Drawing set shall be used for this purpose alone, shall be kept separate from other Plan sheets, and shall be clearly marked as Record Drawings. These Record Drawings shall be kept on site at the Contractor's field office and shall be available for review by the Contracting Agency at all times. The Contractor shall bring the Record Drawings to each progress meeting for review.

The preparation and upkeep of the Record Drawings is to be the assigned responsibility of a single, experienced, and qualified individual. The quality of the Record Drawings, in terms of accuracy, clarity, and completeness, is to be adequate to allow the Contracting Agency to modify the computer-aided drafting (CAD) Contract Drawings to produce a complete set of Record Drawings for the Contracting Agency without further investigative effort by the Contracting Agency.

The Record Drawing markups shall document all changes in the Work, both concealed and visible. Items that must be shown on the markups include but are not limited to:

- Actual dimensions, arrangement, and materials used when different than shown in the Plans.
- Changes made by Change Order or Field Order.
- Changes made by the Contractor.
- Accurate locations of storm sewer, sanitary sewer, water mains and other water appurtenances, structures, conduits, light standards, vaults, width of roadways, sidewalks, landscaping areas, building footprints, channelization and pavement markings, etc. Include pipe invert elevations, top of castings (manholes, inlets, etc.).

If the Contract calls for the Contracting Agency to do all surveying and staking, the Contracting Agency will provide the elevations at the tolerances the Contracting Agency requires for the Record Drawings.

When the Contract calls for the Contractor to do the surveying/staking, the applicable tolerance limits include, but are not limited to the following:

	<u>Vertical</u>	<u>Horizontal</u>
As-built sanitary & storm invert and grate elevations	± 0.01 foot	± 0.01 foot
As-built monumentation	± 0.001 foot	± 0.001 foot
As-built waterlines, inverts, valves, hydrants	± 0.10 foot	± 0.10 foot
As-built ponds/swales/water features	± 0.10 foot	± 0.10 foot
As-built buildings (fin. Floor elev.)	± 0.01 foot	± 0.10 foot
As-built gas lines, power, TV, Tel, Com	± 0.10 foot	± 0.10 foot
As-built signs, signals, etc.	N/A	± 0.10 foot

Making Entries on the Record Drawings:

- Use erasable colored pencil (not ink) for all markings on the Record Drawings, conforming to the following color code:
 - Additions - Red
 - Deletions - Green
 - Comments - Blue
 - Dimensions - Graphite
- Provide the applicable reference for all entries, such as the change order number, the request for information (RFI) number, or the approved shop drawing number.
- Date all entries.
- Clearly identify all items in the entry with notes similar to those in the Contract Drawings (such as pipe symbols, centerline elevations, materials, pipe joint abbreviations, etc.).

The Contractor shall certify on the Record Drawings that said drawings are an accurate depiction of built conditions, and in conformance with the requirements detailed above. The Contractor shall submit final Record Drawings to the Contracting Agency. Contracting Agency acceptance of the Record Drawings is one of the requirements for achieving Physical Completion.

1-10 TEMPORARY TRAFFIC CONTROL

To disrupt public traffic as little as possible, the Contractor shall permit traffic to safely pass through the work with the least possible inconvenience or delay. The Contractor shall maintain existing roads, streets, sidewalks, and paths within the project limits, keeping them open, and in good, clean, safe condition at all times. Contractor is to develop, publish, and post on site specific traffic control plans for vehicles, pedestrians, bicycles, Mercer Island school busses, Metro busses, equestrians, and persons with disabilities. Deficiencies caused by the Contractor's operations shall be repaired at the Contractor's expense. Deficiencies not caused by the Contractor's operations shall be repaired by the Contractor when directed by the Engineer, at the Contracting Agency's expense. The Contractor shall also maintain roads, streets, sidewalks, and paths adjacent to the project limits when affected by the Contractor's operations. The Contractor shall perform the following:

1. The Contractor shall submit a detailed construction plan which identifies pavement cutting; pavement, walkway removals; trenching, pipe laying, backfilling and trench restoration; landscaping restoration; and final cleanup prior to beginning the work.
2. The Contractor shall maintain at least one lane of alternating 2-way traffic. Lane closure is allowable with advanced written approval from the City of Mercer Island; vehicle waits shall be limited to 5 minutes; excluding emergency medical or fire response vehicles which shall have immediate access.
3. The Contractor shall not block access to businesses or homes unless coordinated in advance and in writing with the property owner.

4. The Contractor shall not store any materials on the street overnight, unless otherwise authorized by the Engineer. Those materials stored on the street during working hours are to be used completely during the day in which they are stored. Equipment and vehicles may be parked on the public right-of-way overnight as authorized by the Engineer, but shall not interfere with traffic, pedestrian travel, driveway access, or resident parking.
5. The Contractor shall clear the work site at the end of every work day by the time specified as normal working hours and shall have completed all backfilling, temporary paving, removed all unused materials, and swept up all debris, dirt and excess materials and removed them from the street and walkways. Steel plates may be used only for pre-digging connections or when CDF is required as backfill. The edges of the plates shall be ramped with temporary hot mix asphalt to provide a smooth transition to the existing pavement.
6. Public access to residential streets shall be maintained throughout the project. Maintain driveways to properties which do not have another access and schedule their construction to minimize the impact to the property owner.
7. Safe routes for pedestrians shall be provided through the entire length of the project.
8. Remove or repair any condition resulting from the work that might impede traffic or create a hazard.
9. Maintain existing permanent signing. Repair of signs will be at the Contracting Agency's expense, except those damaged due to the Contractor's operations.
10. Keep drainage structures clean to allow for free flow of water. Cleaning of existing drainage structures will be at the Contracting Agency's expense when approved by the Engineer, except when flow is impaired due to the Contractor's operations.

1-10.1(2) Description

(May 25, 2006 APWA GSP)

Revise the third paragraph to read:

The Contractor shall provide signs and other traffic control devices not otherwise specified as being furnished by the Contracting Agency. The Contractor shall erect and maintain all construction signs, warning signs, detour signs, and other traffic control devices necessary to warn and protect the public at all times from injury or damage as a result of the Contractor's operations which may occur on highways, roads, streets, sidewalks, or paths. No work shall be done on or adjacent to any traveled way until all necessary signs and traffic control devices are in place.

All traffic control must comply with the requirements of the Manual on Uniform Traffic Control Devices (MUTCD), including but not limited to flagging, signage, and all other traffic control devices used. Sample Section K traffic control plans published by WSDOT are available in the Appendix of these Specifications as a guide for developing a site specific traffic control plan. The Contractor shall submit a site-specific traffic control plan for all work within the project limits for review and approval by the City prior to beginning construction.

1-10.2 Traffic Control Management

1-10.3(1)A Flaggers and Spotters

Supplement

A minimum of two (2) flaggers will be required at all times.

1-10.3(3)A Construction Signs

(Special Provision)

Supplement

Construction Identification Signs

Seven working days prior to commencement of work the Contractor shall pick up project notification signs from the City's Maintenance Warehouse Facility located at 9601 SE 36th, Mercer Island, WA 98040, and install on each approach to the project or as directed by the Engineer. The signs will be furnished by the City.

Contractor shall install signs at locations directed by the City. Contractor to move project signs as work progresses as directed by the City.

All costs in connection with the delivery, installation, and maintenance of the signs, the removal at the Substantial Completion Date of the project, and the furnishing, installation, maintenance, removal, and site restoration at the Substantial Completion Date of the project shall be considered **incidental** to and included in the unit contract prices of other items in this contract.

The Contractor shall return the signs in good condition to the City's Maintenance Warehouse upon completion of the project.



**CITY OF MERCER ISLAND
MERCER ISLAND, WASHINGTON**

BOOSTER CHLORINATION SYSTEM

TECHNICAL SPECIFICATIONS

100% SUBMITTAL

VOLUME 1 OF 2

May 2021



Divisions 01, 08, 09, 10, 21, 22, 43, and 46
Division 40 except Section 40_90_00;
Sections 33_05_00.01, 33_05_19



Divisions 31 and 32;
Section 33_05_18



Division 26;
Section 40_90_00



Divisions 03 and 05;
Section 01_81_02



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CITY OF MERCER ISLAND
BOOSTER CHLORINATION SYSTEM
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SECTION 01_11_00

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Detailed description of the Work.

1.02 THE WORK

- A. The Work consists of several components:
1. Main Pump station at Rotary Park - Modifications to the existing pump station suction, discharge, and yard piping. Providing and installing an onsite sodium hypochlorite generation system, including generators, water softeners, brine tank, product storage tanks, hydrogen gas management system, instrumentation, and controls. Providing and installing a sodium hypochlorite dosing system, including metering pumps, injection equipment, instrumentation and controls. Providing and installing a reservoir mixing system. Performing electrical work to support new equipment.
 2. 89th Ave SE Piping - Modification of existing 24-inch and 30-inch transmission piping located adjacent to Rotary Park beneath 89th Ave SE.
 3. Pipeline decommissioning - Decommissioning and abandoning in place a pipeline. This work includes isolating the pipeline from the system at three locations and installing two new fire hydrants.
 4. New PRV and metering station at SE 40th St - Demolition of existing two pressure reducing valves and installation of a PRV in a vault and a new control valve and flow meter.
- B. In addition to the work listed above, the project also includes an additive bid alternative. Low bid award will be based on the work described above. The City will then determine whether to proceed with the additive bid alternatives based upon overall budget status and price indicated by the apparent low bid contractor:
1. Additive bid: Air vacuum/air relief replacement. Remove existing 4-inch AR/AV and associated appurtenances from a pipeline between 89th Ave SE and the Main Pump Station to the point of connection at the pipe. Replace with 2-inch AR/AV with appurtenances, including valve box and vent, as indicated on drawings.

1.03 LOCATION OF PROJECT

- A. The Work occurs at several locations on Mercer Island, King County, Washington:
1. Main Pump Station located in Rotary Park.
 2. 4300 block on 89th Ave SE, including intersections of 89th Ave SE with SE 43rd St and with SE 44th St.
 3. 4400 block on 92nd Ave SE.
 4. Intersection of E Mercer Way and Cedars East Rd.
 5. Intersection of SE 40th St and 97th Ave SE.
- B. Locations are detailed on Civil drawings.

1.04 UTILITIES

- A. The Contractor shall secure a hydrant meter with approved backflow device from the City for obtaining water from the existing system during construction. A deposit of \$2,900 is required for the meter. All water used during construction must be obtained through the hydrant meter and backflow device. The hydrant meter and backflow device must be returned to the City at the end of the Project, after which the City will invoice the Contractor for water usage. Upon payment of the water charges, and after confirmation of no damage to the assembly, the City will return the full deposit to the Contractor.
- B. A Washington State Certified Backflow Assembly tester must test and provide a report to the City Inspector EACH TIME before the assembly is connecting to the City Water System. All costs associated with the testing and maintenance of the backflow assembly shall be incidental to associated bid items.

1.05 OWNER FURNISHED EQUIPMENT

- A. One existing chlorine analyzer will be reused as part of the design. Contractor to make adjustments as shown on the drawings.

1.06 ACTIVITIES BY OTHERS

- A. Owner, utilities, and others may perform activities within the project areas while the Work is in progress:
 - 1. Schedule the Work with Owner, utilities, and others to minimize mutual interference.
- B. Owner will contract with Brown and Caldwell to provide process integration and programming services. Contractor shall provide all hardware and complete wiring connections. Contractor shall coordinate with Brown and Caldwell for required integration testing to confirm correct connections.

1.07 COORDINATION OF CONTRACT DOCUMENTS

- A. Any inconsistency in the parts of the contract shall be resolved by following this order of precedence (e.g. 1 presiding over 2, 2 over 3, 3 over 4, and so forth):
 - 1. Change Orders.
 - 2. Work Directives.
 - 3. Addenda.
 - 4. Contract plans.
 - 5. Technical specifications in CSI format.
 - 6. WSDOT Standard Plans for Road, Bridge, and Municipal Construction.

1.08 MEASUREMENT AND PAYMENT FOR WORK

- A. It is the intention of these specifications that the performance of all work under the bid for each item shall result in the complete construction in an accepted operating condition, of each item.
- B. Work and material not specifically listed in the proposal, but required according to the contract plans, specifications, and general practice shall be included in the

contractor's bid price. No separate payment of any kind will be made for these incidental items.

- C. The Contract Price shall constitute full compensation for furnishing all plans, labor, equipment, incidentals and materials, applicable sales tax for materials and equipment, and performing all operations required to complete the work, as specified, as shown on the Contract Plans or as otherwise directed. Notwithstanding the omission or mention of any incidental work, the Contract Price and payment shall also constitute full compensation for all work incident or incidental to completion of the item, unless such work is otherwise specifically mentioned for separate payment under another bid item. In the event any work is required by the Specifications or by the Proposal, or which is not directly incident or incidental to the completion of any such item, the Contract Price of all enumerated items shall also constitute full compensation for such work.

- D. Unless a specific bid item for the following work has been provided in the Proposal/Construction Contract, or the work has been included in a bid item, such work shall be considered incidental to and included in the various bid items of work. Such work includes, but is not limited to, the following:
 - 1. Furnishing Manufacturer's Certificates of Compliance.
 - 2. Clearing and grubbing.
 - 3. Removal of structures and obstructions.
 - 4. Excavation including haul for trenching.
 - 5. Protection of existing trees to remain.
 - 6. Securing a disposal site and disposal of waste materials.
 - 7. Haul.
 - 8. Sawcutting and slurry vacuuming.
 - 9. Milling or saw cutting pavement.
 - 10. Watering.
 - 11. Dust control.
 - 12. Trimming and cleanup.
 - 13. Construction Staking.
 - 14. Pre-construction photographs.
 - 15. Street cleaning.
 - 16. Striping.
 - 17. Landscape restoration.
 - 18. Dewatering.

- E. Under the contract, no separate or extra payment of any kind shall be made for the incidental work items.

- F. Lump Sum Items:
 - 1. Bid Item A1: West Yard Piping Installation and Modification:
 - a. Measurement:
 - 1) Includes all work related to the piping work in the pump station west yard including pipe, fittings, valves, thrust restraints, trenching, landscaping, demolition of existing flow meter and manhole, wall penetration into the pump station, and pump suction header connection pipe. Also includes all planning associated with this work required under Section 01_14_00 - Work Restrictions and disinfection requirements per Section 01_75_18 - Disinfection.

- 2) Does not include:
 - a) Backfill materials. Labor and materials for backfill are to be included in Item 12.
 - b) Hot Mix Asphalt. Labor and materials for hot mix asphalt are to be included in Item 13.
 - b. Payment:
 - 1) Lump Sum.
2. Bid Item A2: East Yard Piping Installation and Modification:
- a. Measurement:
 - 1) Includes all work related to the piping work in the pump station east yard including pipe, fittings, valves, motorized valve actuators, thrust restraints, trenching, chemical injection vault, rockery removal/reinstallation, flushing assembly, and demolition of existing pressure relief valve and manhole. Also includes all planning associated with this work required under Section 01_14_00 - Work Restrictions and disinfection requirements per Section 01_75_18 - Disinfection.
 - 2) Does not include:
 - a) Backfill materials. Labor and materials for backfill are to be included in Item 12.
 - b) Hot Mix Asphalt. Labor and materials for hot mix asphalt are to be included in Item 13.
 - b. Payment:
 - 1) Lump Sum.
3. Bid Item A3: Pump Station Piping Work:
- a. Measurement:
 - 1) Includes all pump station piping work including pipe spools, flange adapters, valve, and dismantling joint in the Pump Room. Item also includes installation, operation, and removal of a temporary pumping system, meeting requirements of Section 01_50_00 - Temporary Facilities and Controls, which is needed to perform the pump station piping work. Also includes all planning associated with this work required under Section 01_14_00 - Work Restrictions and disinfection requirements per Section 01_75_18 - Disinfection.
 - b. Payment:
 - 1) Lump Sum.
4. Bid Item A4: Sodium Hypochlorite Generation System Installation:
- a. Measurement:
 - 1) Includes all work related to providing and installing a new sodium hypochlorite generation system including generators, water softener, brine tank, product storage tanks, hydrogen gas management system, water heater, safety shower/eye wash and water heater, chemical metering pump skid, all chemical piping, chemical injectors, chlorine analyzers, interconnecting piping, fittings and valves, generation related instrumentation and controls, floor modification and drain installation, and all other items specified on project plans and specifications. Also includes all planning associated with this work required under Section 01_14_00 - Work Restrictions and disinfection requirements per Section 01_75_18 - Disinfection.

- b. Payment:
 - 1) Lump Sum.
- 5. Bid Item A5: Reservoir Tank Mixers Installation:
 - a. Measurement:
 - 1) Includes all work related to providing and installing new reservoir tank mixers including all materials and work required to complete the mixers installation and ready for operations. Also includes all planning associated with this work required under Section 01_14_00 - Work Restrictions and disinfection requirements per Section 01_75_18 - Disinfection.
 - b. Payment:
 - 1) Lump Sum.
- 6. Bid Item A6: Electrical, Instrumentation, and Control Equipment Installation and Integration:
 - a. Measurement:
 - 1) Includes all work related to the electrical, instrumentation, and control equipment installation and integration as specified on the project plans and specifications. Also includes all planning associated with this work required under Section 01_14_00 - Work Restrictions.
 - b. Payment:
 - 1) Lump Sum.
- 7. Bid Item A7: 89th Ave SE Piping Installation and Modification:
 - a. Measurement:
 - 1) Includes all work related connecting the 30-inch and 24-inch water mains as specified on the project plans and specifications. Includes all erosion control measures and excavation and support and protection. Also includes all planning associated with this work required under Section 01_14_00 - Work Restrictions and disinfection requirements per Section 01_75_18 - Disinfection.
 - 2) Does not include:
 - a) Traffic Control. All traffic control measures will be included in Item 11.
 - b) Backfill materials. Labor and materials for backfill are to be included in Item 12.
 - c) Hot Mix Asphalt. Labor and materials for hot mix asphalt are to be included in Item 13.
 - d) Flaggers. All flagger labor hours are to be included in item 14.
 - b. Payment:
 - 1) Lump Sum
- 8. Bid Item A8: Fire Hydrant Installation and Modification:
 - a. Measurement:
 - 1) Includes all work related to installing two new fire hydrants, one at 92nd Ave SE and one in the proximity of 4400 East Mercer Way as specified on the project plans and specification. Includes all erosion control measures and excavation and support and protection. Also includes all planning associated with this work required under Section 01_14_00 - Work Restrictions and disinfection requirements per Section 01_75_18 - Disinfection.

- 2) Does not include:
 - a) Traffic Control. All traffic control measures will be included in Item 11.
 - b) Backfill materials. Labor and materials for backfill are to be included in Item 12.
 - c) Hot Mix Asphalt. Labor and materials for hot mix asphalt are to be included in Item 13.
 - d) Flaggers. All flagger labor hours are to be included in item 14.
 - b. Payment:
 - 1) Lump Sum.
9. Bid Item A9: Pressure Relief Valve and Flow Meter Vault Replacement and Installation:
- a. Measurement:
 - 1) Includes all work related to demoing existing pressure relief valve vaults and installing a new pressure relief valve vault and meter vault as specified on the project plans and specifications. Includes all erosion control measures and excavation and support and protection. Also includes all planning associated with this work required under Section 01_14_00 - Work Restrictions and disinfection requirements per Section 01_75_18 - Disinfection.
 - 2) Does not include:
 - a) Traffic Control. All traffic control measures will be included in Item 11.
 - b) Backfill materials. Labor and materials for backfill are to be included in Item 12.
 - c) Hot Mix Asphalt. Labor and materials for hot mix asphalt are to be included in Item 13.
 - d) Flaggers. All flagger labor hours are to be included in item 14.
 - b. Payment:
 - 1) Lump Sum.
10. Bid Item A10: Decommission of Existing Water Main:
- a. Measurement:
 - 1) Includes all work related to modifying and capping the existing decommission water main from the Rotary Park area to E Mercer Way, as specified on the project plans and specification. Includes all erosion control measures and excavation and support and projection. Also includes all planning associated with this work required under Section 01_14_00 - Work Restrictions and disinfection requirements per Section 01_75_18 - Disinfection.
 - 2) Does not include:
 - a) Traffic Control. All traffic control measures will be included in Item 11.
 - b) Backfill materials. Labor and materials for backfill are to be included in Item 12.
 - c) Hot Mix Asphalt. Labor and materials for hot mix asphalt are to be included in Item 13.
 - d) Flaggers. All flagger labor hours are to be included in item 14.
 - b. Payment:
 - 1) Lump Sum.

11. Bid Item A11: Traffic Control Measures:
 - a. Measurement:
 - 1) Includes labor and materials required for management including but not limited to temporary striping, signage, delineators, Jersey shape barriers, cones, temporary fence, and equipment necessary for traffic control during the project.
 - 2) Creating, submitting, receiving approved traffic control plan (TCP), and implementation of the approved TCP per Section 1-10 of the WSDOT Standard Specifications.
 - 3) Does not include:
 - a) Flaggers. All flagger labor hours are to be included in item 14.
 - b. Payment:
 - 1) Lump Sum.

G. Unit Cost Items:

1. Bid Item A12: Backfill Materials - 5/8-inch Minus Crushed Rock:
 - a. Measurement:
 - 1) Includes all labor and materials required for backfill per Sections 31_00_00 - Earthwork, 31_05_15 - Soils and Aggregates for Earthwork, and 31_23_35 - Trenching, including but not limited to excavation, hauling excavated material, disposal of excavated material, hauling backfill material to the project site, aggregates for backfill, and backfilling excavations.
 - 2) Labor and materials required for excavation support shall be included in other items.
 - b. Payment:
 - 1) Per ton.
2. Bid Item A13: Hot Mix Asphalt – Class B:
 - a. Measurement:
 - 1) Includes all labor and materials for pavement replacement per Sections 31_05_15 - Soils and Aggregates for Earthwork, 32_01_15 - Pavement Restoration and Rehabilitation, and 32_12_15 - Asphaltic Concrete Paving, including demolition and hauling of existing asphalt, transporting the material to the project site, and other appurtenant work and materials.
 - 2) Backfill shall be included in Item 12 – Backfill Materials.
 - b. Payment:
 - 1) Per ton.
3. Bid Item A14: Traffic Flagger:
 - a. Measurement:
 - 1) Includes labor and material for traffic flagger(s) to support the Traffic Control Measures for the duration of the project.
 - b. Payment:
 - 1) Per hour.

H. Bid Alternate Items:

1. Bid Item B1 – Air vacuum/air relief replacement:
 - a. Measurement:
 - 1) Includes labor and material for the removal of the existing air and vacuum relief assembly on the 24-inch water main between

89th Ave SE and the east yard piping and installation of a new assembly. Work includes all planning associated with this work required under Section 01_14_00 - Work Restrictions and disinfection requirements per Section 01_75_18 - Disinfection.

- 2) Includes but not limited to excavation and backfill as required.
- b. Payment:
- 1) Lump Sum.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01_11_02

CONTRACT DOCUMENT LANGUAGE

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Explanation of arrangement, language, reference standards, and format.

1.02 REFERENCES

- A. Construction Specifications Institute (CSI):
 1. MasterFormat™.
 2. SectionFormat™.
 3. PageFormat™.

1.03 PROJECT MANUAL ARRANGEMENT

- A. Document and Section numbers used in Project Manual, and Project Manual arrangement are in accordance with CSI MasterFormat™, except where departures have been deemed necessary.
- B. Sections are written in CSI SectionFormat™, Three-Part Section Format, except where departures have been deemed necessary.
- C. Page format for Sections in the Project Manual is in PageFormat™, except where departures have been deemed necessary.

1.04 CONTRACT DOCUMENT LANGUAGE

- A. Specification Section Paragraphs entitled "Section Includes" summarize briefly what is generally included in the section:
 1. Requirements of Contract Documents are not limited by "Section Includes" paragraphs.
- B. Specifications have been partially streamlined by intentionally omitting words and phrases, such as "the Contractor shall," "in conformity therewith," "shall be" following "as indicated," "a," "an," "the" and "all:"
 1. Assume missing portions by inference.
- C. Phrase "by Engineer" modifies words such as "accepted," "directed," "selected," "inspected," and "permitted," when they are unmodified.
- D. Phrase "to Engineer" modifies words such as "submit," "report," and "satisfactory," when they are unmodified.

- E. Colons (:) are used to introduce a list of particulars, an appositive, an amplification, or an illustrative quotation:
 - 1. When used as an appositive after designation of product, colons are used in place of words "shall be."
- F. Word "provide" means to manufacture, fabricate, deliver, furnish, install, complete, assemble, erect in place, test, or render ready for use or operation, including necessary related material, labor, appurtenances, services, and incidentals.
- G. Words "Contractor shall" are implied when direction is stated in imperative mood.
- H. Term "products" includes materials and equipment as specified in Section 01_60_00 - Product Requirements.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01_14_00

WORK RESTRICTIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements for scheduling the Work affected by existing site and facility, work restrictions, and coordination between construction operations and distribution system and pump station operations. Restrictions in this section supplement those indicated in the General Terms and Conditions.

1.02 GENERAL CONSTRAINTS ON WORK AND SCHEDULING OF WORK

- A. Access:
 - 1. Parking may be limited in the area surrounding the Rotary Park Pump Station, as there is a high school nearby. Contractor shall be prepared to transport workers to the site at no additional cost to the owner if parking is unavailable on work days.
 - 2. Work will be required in the right-of-way. Generally, Contractor coordinate access route and stage work to maintain emergency access at all times:
 - a. It is anticipated that, due to limited access and work required for the replacement of fire hydrant at 92nd Ave SE, local access to homes will not be able to be maintained during this street closure. Work shall be planned to limit this lack of access to one working day. Additionally, contractor shall have steel plates and equipment on site to provide emergency vehicle access at all times while properties are impacted by the temporary street closures.
- B. Equipment:
 - 1. Contractor shall provide all necessary equipment for completing work. Existing infrastructure (e.g. bridge crane in the Pump Station) shall be assumed to be inoperable.
- C. Work near gas lines:
 - 1. The contractor shall notify Puget Sound Energy (PSE) 48 hour in advance and coordinate construction prior to excavation near gas mains. The PSE representative shall (at a minimum) be onsite for construction around 4-inch diameter and larger and/or high pressure gas main. Provide sand bedding per PSE requirements.
 - 2. Locations of existing gas lines that will impact work include:
 - a. Fire hydrant replacement in 92nd Ave SE.
 - b. PRV and Metering station work at SE 40th St.
- D. Work near transmission mains:
 - 1. The contractor shall coordinate construction with Seattle Public Utilities (SPU) prior to excavation near their transmission main.
 - 2. Locations of existing transmission main that will impact work include:
 - a. PRV and Metering station work at SE 40th St.

E. Water projects:

1. The distribution system including the Rotary Park Pump Station is the Owner's sole source of drinking water.
2. Conduct Work such that the Owner's ability to meet its customer's demands for treated drinking water shall not be impaired or reduced in terms of the required quantity or quality of treated water. Do not impair the operational capabilities of essential elements of the process or capacity below levels sufficient to meet demands for water throughout the contract time. The quantities of and quality of treated water required are described in this Section.
3. Conduct commissioning activities as specified in Section 01_75_17 - Commissioning in a manner that will not impair capabilities of essential elements of the process or reduce treatment capacity below levels sufficient to meet demands for water throughout the contract time. The quantities of and quality of treated water required are described in this Section.
4. PCIS Optimization and Fine-Tuning as specified in Section 01_75_17 - Commissioning.
5. The status of the facility shall be defined as "operational" when the facility is capable of meeting the Owner's customer's demands for treated drinking water in terms of the required quantity or quality of treated water as defined in this Section.
6. Connection to existing mains:
 - a. The Contractor shall verify existing pipeline material, size, outside diameter, and location prior to starting connections to the existing water system. The City Inspector must inspect and approve all materials on hand at least one (1) week in advance of any water main connections.

F. Draining piping:

1. Portions of the work will require draining sections of piping. Sewer manholes have been identified on the drawings for discharge of drainage following dechlorination.
2. Contractor shall dechlorinate to an undetectable residual before discharging.
3. Once piping to be drained has been exposed by the contractor, the Owner shall provide a tap on the piping to facilitate controlled draining by the Contractor.
4. Draining of piping shall be conducted at a controlled rate as to not overwhelm sewer systems. Allowable drainage rate is anticipated to be 100 gpm. A higher drainage rate may be accommodated based on conditions on the day work is performed, at the Owner's discretion, but Contractor shall assume this maximum rate in planning activities.
5. The Owner anticipates that, due to age, even when closed, existing isolation valves in the distribution system will leak. Contractor shall be prepared to accommodate a flow of up to 25 gpm of leakage out of piping following isolation. This leakage will need to be dechlorinated and discharged to the sewer.

G. System Operations:

1. Unless otherwise identified in documents, shutdowns that result in service loses shall be limited to six hours.
2. Owner shall operate valves and pumps and perform any taps on the active distribution system. Contractor shall provide 14 days' notice to the City for valve closures in the distribution system.

H. Hazardous Materials:

1. The Contractor will conduct all work related to existing asbestos cement pipe in strict accordance with current WISHA safety regulations and provisions contained within WAC 296-62-077, and follow the current asbestos abandonment procedures and laws. Removal of existing asbestos cement pipe from the ground, if required, will be permitted only after the proper permits are obtained from the Puget Sound Air Pollution Control Agency. The Contractor will be responsible for all associated fees and permits required for asbestos removal and disposal. The contractor shall provide work crews with proper protective clothing and equipment, or a licensed company and/or licensed supervisor for abatement.
2. Limited sampling for paint containing lead was conducted within the Main Pump Station. Results are provided in Appendix C. If lead coated pipe is encountered during the course of work, Contractor shall be responsible for the abatement and disposal of lead coated piping and appurtenances. Contractor shall take the necessary precautions for compliance with Federal, State, and Local regulations and shall employ work methods that will not expose workers to levels of lead that will exceed the Permissible Exposure Level set by the Washington State Department of Labor and Industries.

1.03 SEQUENCING PLAN

- A. Shutdown constraints for major portions of work are indicated below. These descriptions include a potential sequencing steps. These steps do not indicate every element of work required and are only intended to facilitate Contractor's understanding of how the work could proceed.
- B. Contractor shall submit a sequencing plan for each proposed shutdown at least 45 days prior to the shutdown. At a minimum, each sequencing plan shall include:
 1. A description of each step or portion of work.
 2. Time allocated to each step or portion of work.
 3. Any requests for Owner involvement in portions of the work.
- C. Shutdowns may only be performed with an approved sequencing plan.
- D. The sequencing plan shall take into consideration the time needed for pressure and bacteriological testing as specified in Sections 01_75_18 - Disinfection and 40_05_00.09 - Piping Systems Testing.

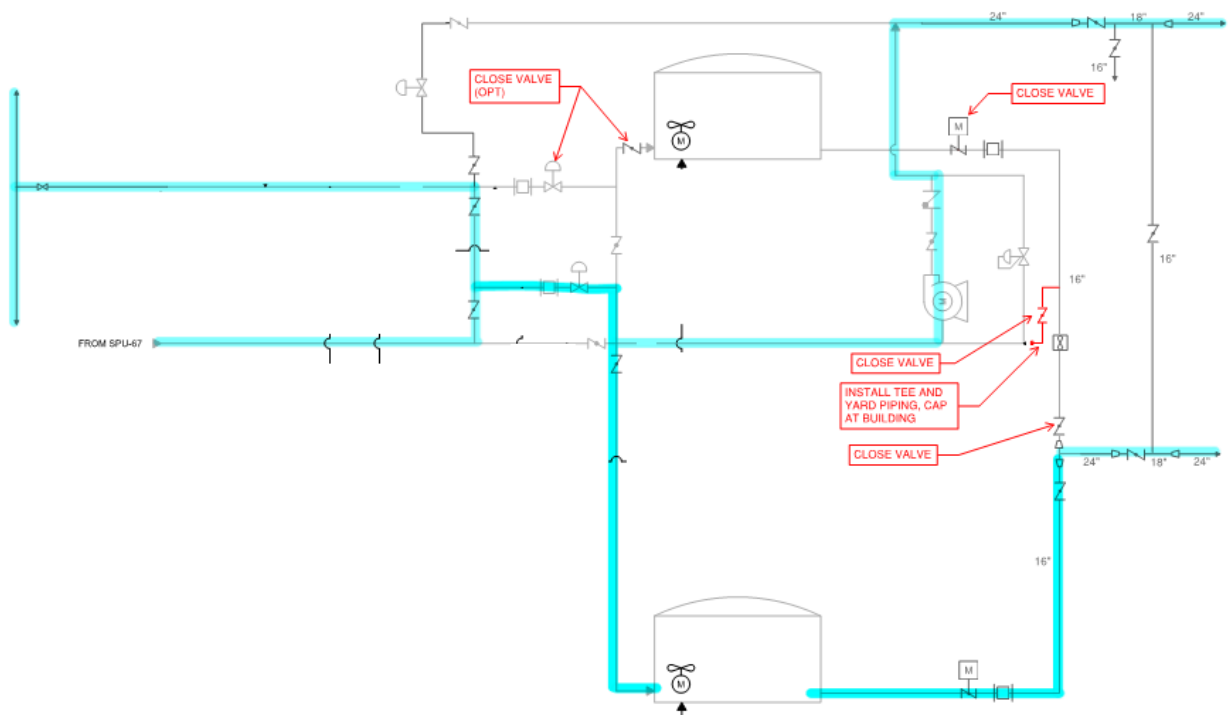
1.04 SHUTDOWN AND CONSTRUCTION CONSTRAINTS

- A. General shutdown constraints:
 1. Execute the Work while the existing facility is in operation.
 2. Most activities may be accomplished without a shutdown.
 3. Apply to activities of construction regardless of process or work area.
 4. Activities that disrupt pump station or utilities operations must comply with these shutdown constraints.
 5. Organize work to be completed in a minimum number of shutdowns.
 6. Provide thorough advanced planning, including having required equipment, materials, and labor on hand at time of shutdown.

7. Where required to minimize system interruptions while complying with specified constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.
 8. Final determination of the permitting of shutdowns will be the sole judgment of the Owner.
 9. Owner maintains the ability to abort on the day of the scheduled shutdown.
- B. General maximum pump station flow work limitations:
1. Activities that disrupt pump station operations are prohibited during the following flow conditions, unless otherwise approved in writing by the Owner and Engineer:
 - a. Flow condition: 7.0 mgd for pump station discharge.
- C. Unit process availability work limitations:
1. Shutdowns and tie-ins or other activities that disrupt pump station operations are prohibited unless the following unit process availability conditions exist and unless otherwise approved in writing by the Owner and Engineer.
 2. At a minimum, the following facilities must be in service in order to proceed with a scheduled shutdown:
 - a. One reservoir fill valve/piping.
 - b. One reservoir.
 - c. Temporary high service pumps as specified in Section 01_50_00 - Temporary Facilities and Controls:
 - 1) At no time shall the high service pump be taken offline without approved temporary pumping facilities.
- D. Shutdown activities:
1. Scheduling:
 - a. Perform as directed by the Engineer and this Section.
 2. Unplanned shutdowns due to emergencies are not defined in this Section.
 3. No shutoff of mains will be permitted on Mondays, Fridays, overnight, over weekends, holidays, or the day before or after holidays, unless otherwise authorized by the Engineer. No more than 35 homes can be affected during a shutdown. Only one (1) shutdown will be scheduled per day, and no more than two (2) shutdowns per week.
- E. Process area construction constraints:
1. The following constraints shall be observed while working in and around each of the following process areas:
 - a. Material hauling operations:
 - 1) Contractor shall comply with restrictions regarding Contractor's use of site and premises as specified in Section 01_11_00 - Summary of Work.
- F. Pump station isolation sequencing:
1. Keep existing pump station pumps in operation at all time during construction, except for one planned shutdown. This planned shutdown will be used for the installation of the new electrical breaker into the existing electrical system,

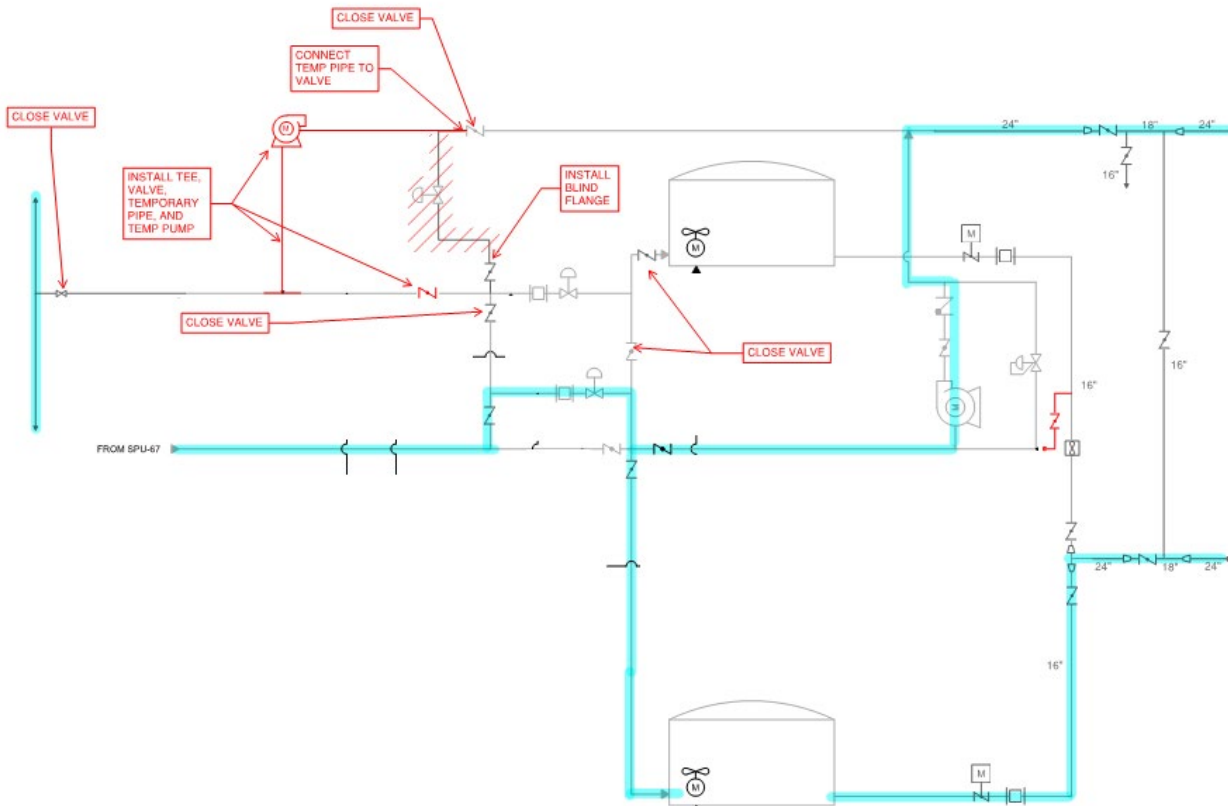
installation of the new pump suction header 24-inch BFV, and connection of new yard piping to the existing pump suction header:

- a. During the planned shutdown the following conditions shall be met:
 - 1) Provided temporary pumping, controls, and power per specification Section 01_50_00 - Temporary Facilities and Controls.
 - 2) The shutdown shall be planned to be less than 2-days and accommodations shall be made to minimize facility downtime to the extent possible.
 - 3) Shutdown shall be performed during low demand season (between October and May).
- b. Pump shutdown sequencing:
 - 1) Schematics are provided below for reference, blue highlight indicates the flow path to maintain water service.
 - 2) Pump Station (PS) Phase 1: Install western yard piping:



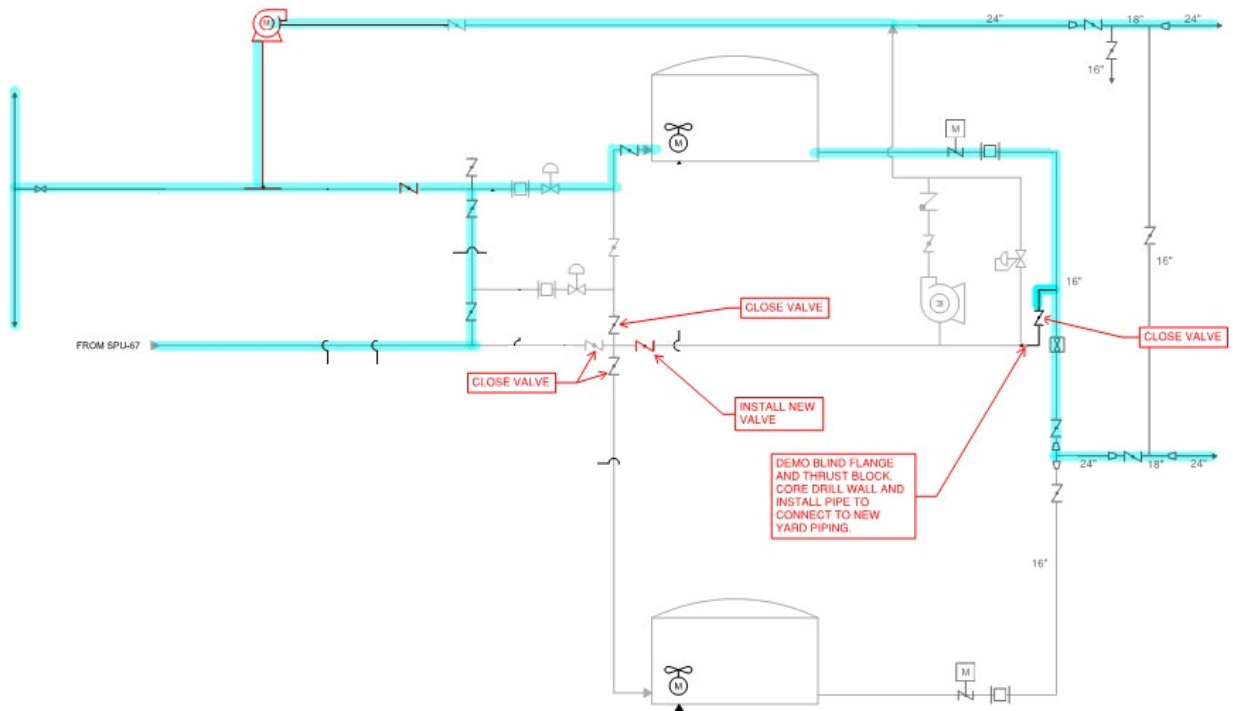
- a) Isolate South Reservoir discharge pipe. Only the Owner may operate system valves.
- b) Perform work associated with the western yard piping, including tie-in to the existing reservoir discharge pipe, fittings, pipe, valves, and ball flex coupling.
- c) The yard piping shall be terminated close enough to the Pump Station that the final connection can be performed with a single length of pipe and with minimal fittings.
- d) Flush, pressure test, disinfect and conduct required bacteriological testing, so that it can be put into service immediately after the connection is performed.
- e) Demolish thrust block and core drill penetration into the pump building.

3) PS Phase 2: Demolish piping, valves, and valve vault on eastern side (rear) of the pump station:



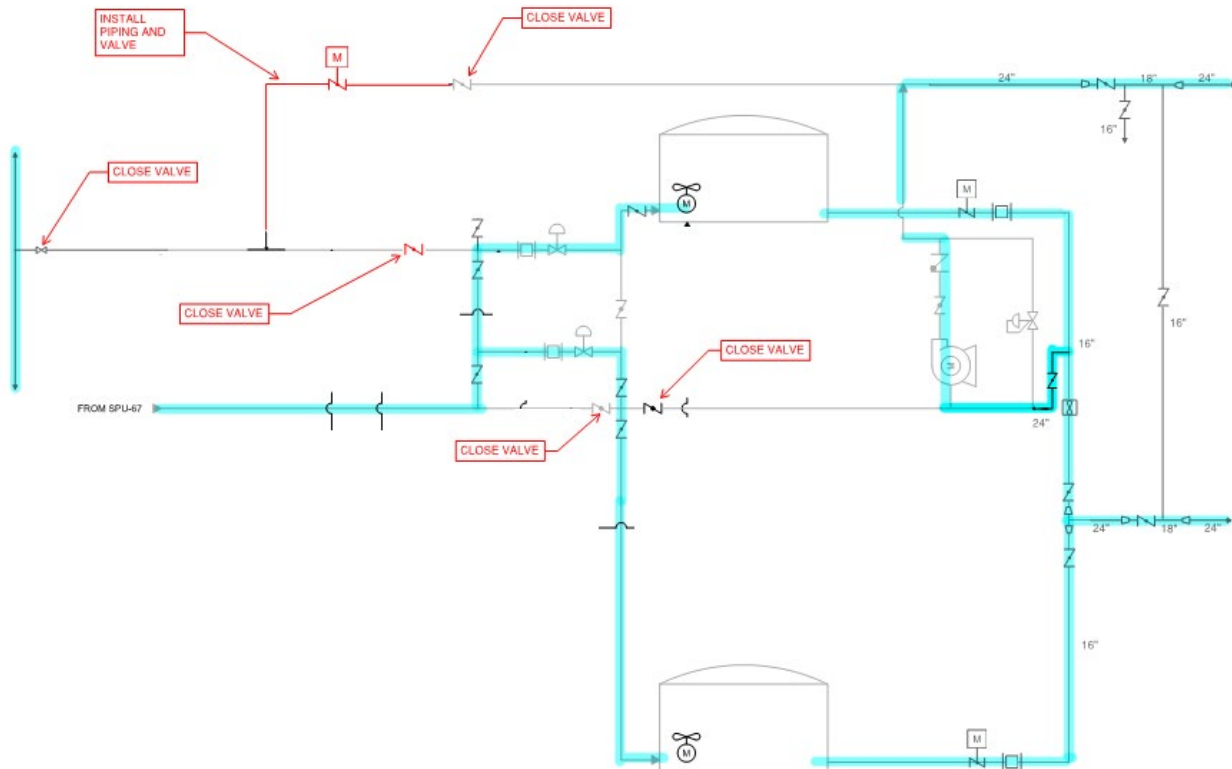
- a) Work for PS Phase 2 can be performed simultaneously with PS Phase 1.
- b) Restrain existing coupling and valve as indicated on Drawing C03 prior to disturbing soil near the existing thrust block/restraint.
- c) Isolate the southern reservoir fill line by closing the indicated valves. Only the Owner may operate existing valves.
- d) Drain piping to the sanitary sewer. Pumping may be required after piping is depressurized.
- e) Demolish valve, piping, and valve vault indicated on Drawing C03. Remove rockery, slope grade, and shore as needed to install new fittings and thrust restraints.
- f) Install new motorized 24 inch BFV and tee. Connect temporary piping to the new tee and existing 16 inch BFV.
- g) Install new spool piece and dismantling joint on south reservoir inlet piping.
- h) Install temporary pumping, controls, and power.

4) PS Phase 3: Pump station shutdown – pump suction header modifications:



- a) Isolate the northern reservoir fill line by closing the indicated valves. Only the Owner may operate system valves.
- b) Begin operating temporary pumping.
- c) Operate temporary pumps for a minimum time specified in Section 01_50_00 - Temporary Facilities and Controls prior to shutdown of the existing pump station pumps.
- d) Shutdown pump station pumps, close pump suction valves, and disconnect power. Only the Owner may operate system valves and equipment.
- e) Drain suction header and perform work indicated on Drawing M04, including installation of the new 24 inch BFV and connection to the western yard piping. Modifications must be disinfected per Section 01_75_18 - Disinfection prior to commissioning.
- f) Install new electrical breaker as shown on Drawing E04.
- g) Commission new valve and piping and resume pump station operations.

5) PS Phase 4: Install eastern yard piping:



- a) Isolate the southern reservoir fill line by closing the indicated valves. Only the Owner may operate system valves.
- b) Remove temporary pumping system.
- c) Install new yard piping, motorized 16-inch valve, and flushing assembly. Install flushing assembly as shown on Drawing C03. Modifications must be disinfected per Section 01_75_18 - Disinfection prior to commissioning.

- G. Upon completion and commissioning of the pipeline and valve work shown on Drawings C02, C03, and M04, the Owner may opt to open the existing and new 16 inch valves to provide pumped distribution service to the Canyon Abandoned Line:
1. Contractor shall provide notice to the City for valve closure 14 days before the shutdown at each location.
 2. Construction Sequencing:
 - a. Schematics are provided in Appendix A for reference.
 - b. Abandoned Line Location 1 at SE 43rd St and 89th Ave SE:
 - 1) City shall provide valve closures as shown in Figure 1 in Appendix A.
 - 2) Dechlorinate and drain approximately 800 gallons in sewer manhole as shown in the Drawings.
 - 3) Remove existing tee and install cap and new straight pipe as shown in Drawings.
 - c. Abandoned Line Location 2 at SE 44th St and 89th Ave SE:
 - 1) City shall provide valve closures as shown in Figure 2 in Appendix A.
 - 2) Dechlorinate and drain approximately 1,200 gallons in sewer manhole as shown in the Drawings.

- 3) Remove existing tee and install cap and new straight pipe as shown in Drawings.
 - d. Relocation of Fire Hydrant on 92nd Ave SE:
 - 1) Utilize existing fire hydrant for temporary vacuum relief.
 - 2) Install new fire hydrant on existing 16 inch Canyon Line as shown on the Drawings.
 - e. Abandoned Line Location 3 at 4400 East Mercer Way:
 - 1) City shall provide valve closures as shown in Figure 3 in Appendix A.
 - 2) Dechlorinate and drain approximately 18,200 gallons in sewer manhole as shown in the Drawings.
 - 3) After completion remove and cap existing fire hydrant at 92nd Ave SE and cap as noted in the Drawings.
- H. New PRV and Meter Vaults at SE 40th St:
1. Contractor shall provide notice to the City for valve closure 14 days before anticipated construction work.
 2. City shall provide valve closures as shown in Figure 4 in Appendix A.
 3. Dechlorinate and drain approximately 410 gallons in sewer manhole as indicated on the Drawings.
 4. Install new work, as shown in the Drawings.
 5. Disinfect, flush, and test after work is completed.
- I. 89th Ave SE Pipe Work and Air Relief/Air Vacuum (AR/AV) valve replacement (bid alternative):
1. Contractor shall provide notice to the City for valve closure 14 days before anticipated construction work.
 2. Work on 89th Ave SE will be performed after all pump station phases have been complete.
 3. Construction Sequencing:
 - a. Schematics are provided in Appendix A for reference.
 - b. Pipe work will not occur during the Rotary Park Pump Station work. Work shall occur before or after the pump station shutdown.
 - c. Piping Plan (PP) Phase 1:
 - 1) Contractor shall install thrust collars on existing 24-inch line as shown on Drawing C04.
 - 2) City shall provide valve closures as shown in Figure 5 in Appendix A.
 - 3) Dechlorinate and drain approximately 11,400 gallons in sewer manhole as shown on the Drawings.
 - 4) Contractor shall perform work on the 30 inch line as shown in the drawings. Install a temporary restraint joint cap as needed on the 24-inch outlet of the 30-inch tee.
 - 5) Water service shutdown limited to 6 hours. All piping work must be completed in the shutdown duration including disinfection and flushing.
 - d. PP Phase 2:
 - 1) City shall provide valve closures as shown in Figure 5 in Appendix A.
 - 2) Dechlorinate and drain 10,400 gallons in sewer manhole as shown on the Drawings. The contractor shall use 4-inch thread connection on installed blind flange on Drawing C03.
 - 3) Contractor shall:
 - a) Remove temporary restraint joint cap on the 24-inch outlet of the 30 in cap.

- b) Install 24-inch tee and connect to the 30-tee.
- c) Cap the north outlet of the 24-inch tee and north 24-inch line with a temporary restraint joint cap.
- d) Install 24-inch tee thrust block.
- 4) If bid alternative for AR/AV valve replacement is selected by City, Contractor shall perform necessary work as shown in the drawings.
- 5) Water service shutdown limited to 6 hours which is inclusive of the time needed for draining. All piping work must be completed in the shutdown duration including disinfection and flushing.
- e. PP Phase 3:
 - 1) City shall provide valve closures as shown in Figure 5 in Appendix A.
 - 2) Dechlorinate and drain 10,400 gallons in sewer manhole as shown on the Drawings. The contractor shall use 4-inch thread connection on installed blind flange on Drawing C03.
 - 3) Contractor shall:
 - a) Remove temporary restraint joint caps on the north outlet of the 24-inch tee and north 24-inch line.
 - b) Connect the 24-inch tee to existing north 24-inch pipe.
 - 4) If bid alternative for AR/AV valve replacement is selected by City, Contractor shall perform necessary work as shown in the drawings.
 - 5) Water service shutdown limited to 6 hours which is inclusive of the time needed for draining. All piping work must be completed in the shutdown duration including disinfection and flushing.

1.05 METHOD OF PROCEDURE (MOP)

- A. MOP Instructions: See Appendix B.
- B. Prepare MOP for the following conditions:
 - 1. Shutdowns, diversions, and tie-ins to the existing facility.
 - 2. Process start-up activities.
 - 3. Power interruption and tie-ins.
 - 4. Switch over between temporary and permanent facilities, equipment, piping, and electrical and instrumentation systems.
 - 5. Process constraints requiring interruption of operating processes or utilities.
- C. Other Work not specifically listed may require MOPs as determined necessary by the Contractor, Owner, or Engineer.
- D. Submit Baseline Schedule, as specified in Section 01_32_21 - Schedules and with proposed MOPs.
- E. Submit MOP Log at construction progress meetings.
- F. No consideration will be given to claims of additional time and cost associated to preparing MOPs required by the Owner and Engineer to complete this work in a manner that facilitates proper operation of the facility and compliance with effluent discharge criteria.
- G. Where required to minimize treatment process interruptions while complying with specified constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.

1.06 REQUIREMENTS FOR MAINTAINING CONTINUOUS OPERATION OF EXISTING FACILITIES

- A. Facilities or conditions required to keep the existing pump station operational include, but are not limited to, the following:
 - 1. Electrical power including transformers, distribution wiring, and motor control centers.
 - 2. SPU water:
 - a. Existing pipelines are provided.
 - 3. Piping for conveyance of water between the fill valves, pump station and storage reservoirs.
 - 4. A means of measuring, controlling, and splitting the water between the two storage reservoirs:
 - a. Accomplished by existing altitude valves and flow meters in the pump pit.
 - 5. Office, toilets, and washrooms.
 - 6. Fencing and gates.
 - 7. Lighting.
 - 8. Heating and ventilation.
 - 9. Instrumentation, meters, controls, and telemetry equipment.
 - 10. Safety equipment and features.
 - 11. Parking for City employees and vehicles required for operation and maintenance.
 - 12. Access to shared storage areas.
 - 13. Telephone system.
 - 14. Storm drainage.
- B. Conduct the Work and provide temporary facilities required to keep the existing facility continuously operational.
- C. Do not remove or demolish existing facilities required to keep the existing pump station operational at the capacities specified until the existing facilities are replaced by temporary, new, or upgraded facilities or equipment:
 - 1. Test replacement facilities to demonstrate operational success prior to removing or demolishing existing facilities.

1.07 OPERATIONS AND MAINTENANCE ACCESS

- A. Provide safe, continuous access to process control equipment for pump station operations personnel.
- B. Provide access on 1-hour advance notice to process control equipment for pump station maintenance personnel and associated maintenance equipment.

1.08 UTILITIES

- A. Provide advance notice for location and marking of underground utilities operated by utility agencies other than the Owner.
- B. Maintain electrical, telephone, water, gas, sanitary facilities, and other utilities within existing facilities in service. Provide temporary utilities when necessary.

- C. New yard and off-site utilities were designed using existing facility drawings:
 - 1. Field verification of utilities locations was not performed during design.
 - 2. Services crossed or located nearby by new yard utilities may require relocation and possible shutdowns.
 - 3. Pipe alignments as indicated on the Drawings.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

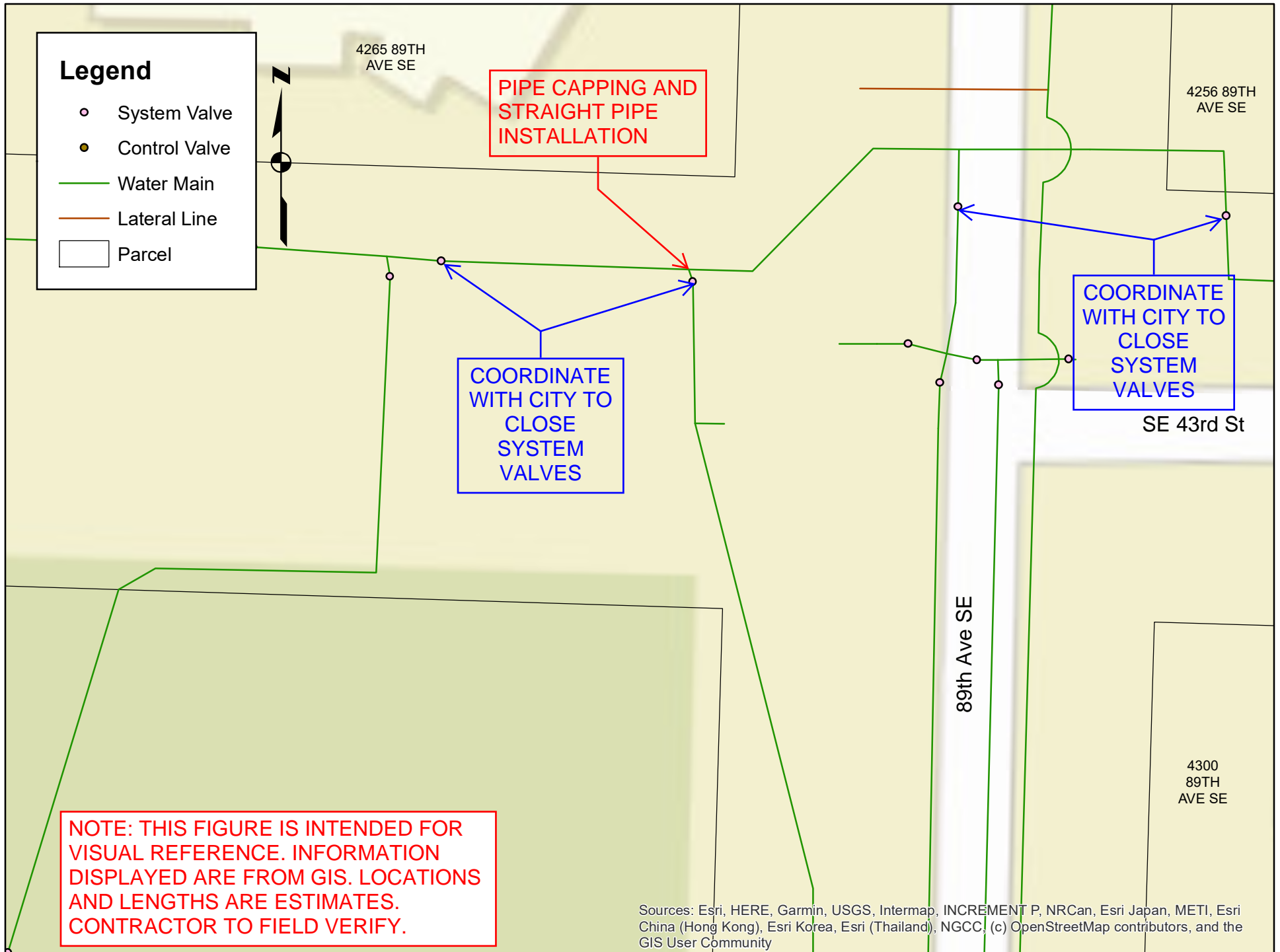


Figure 1 - Abandon Pipe Location 1

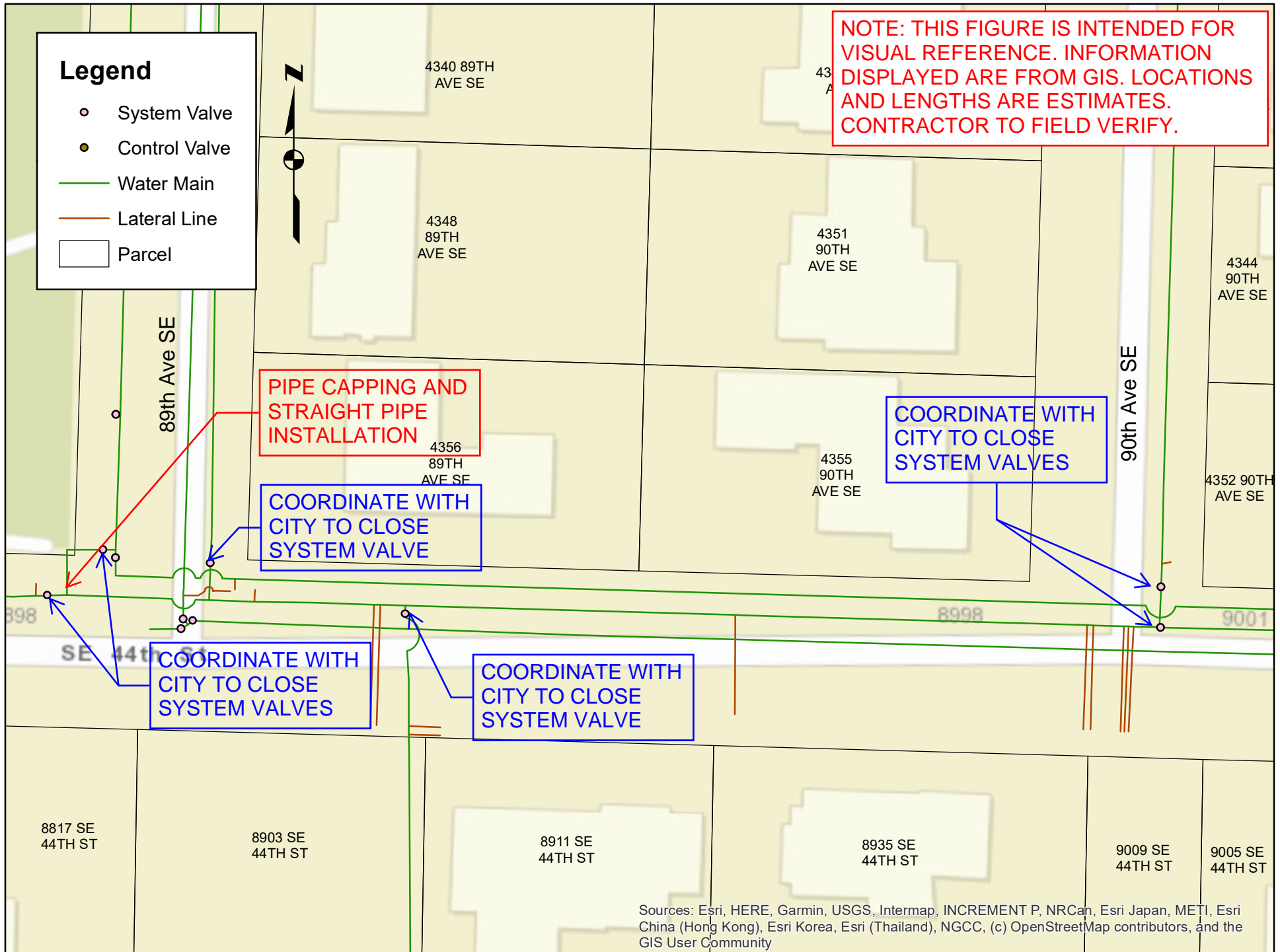


Figure 2 - Abandon Pipe Location 2

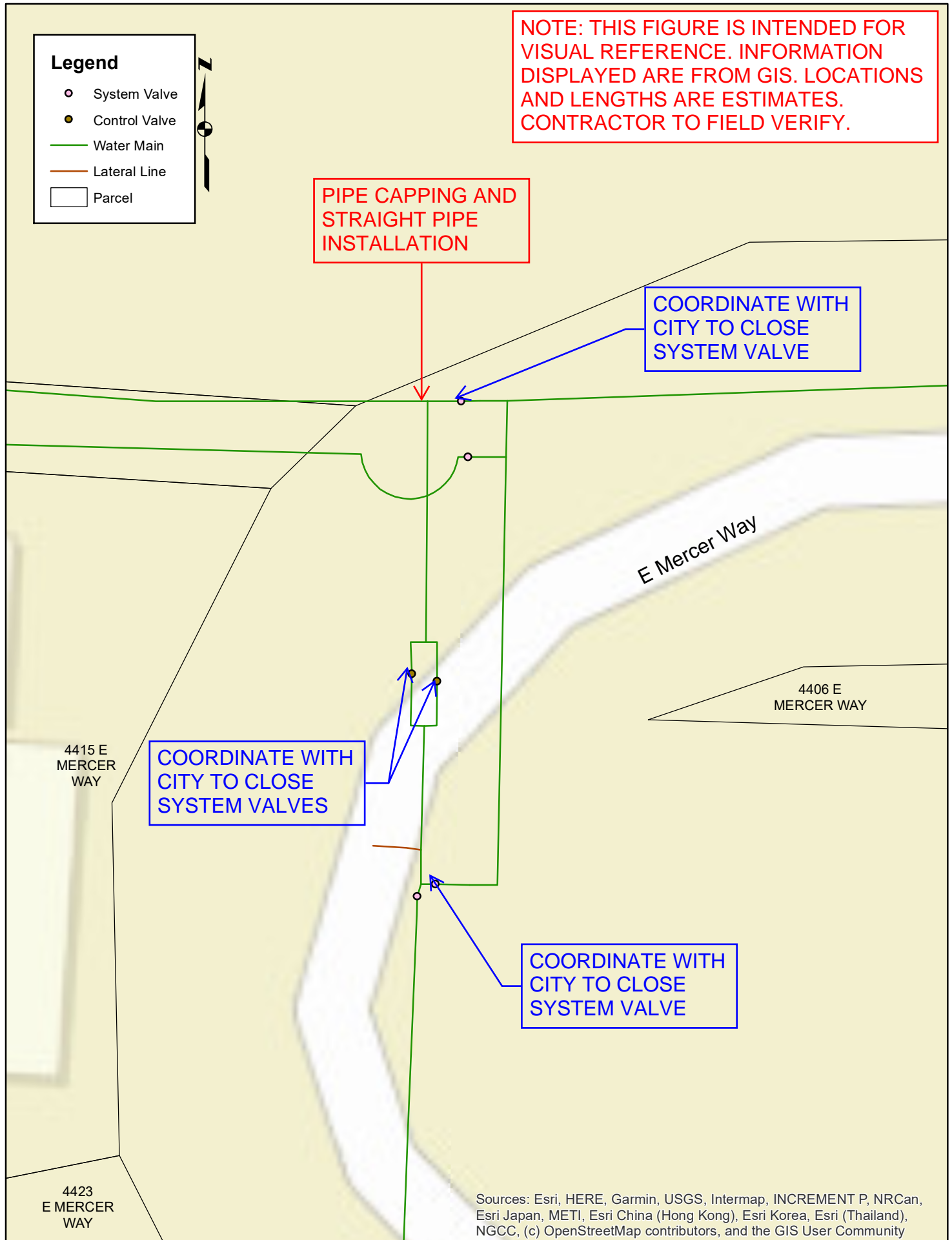


Figure 3 - Abandon Pipe Location 3

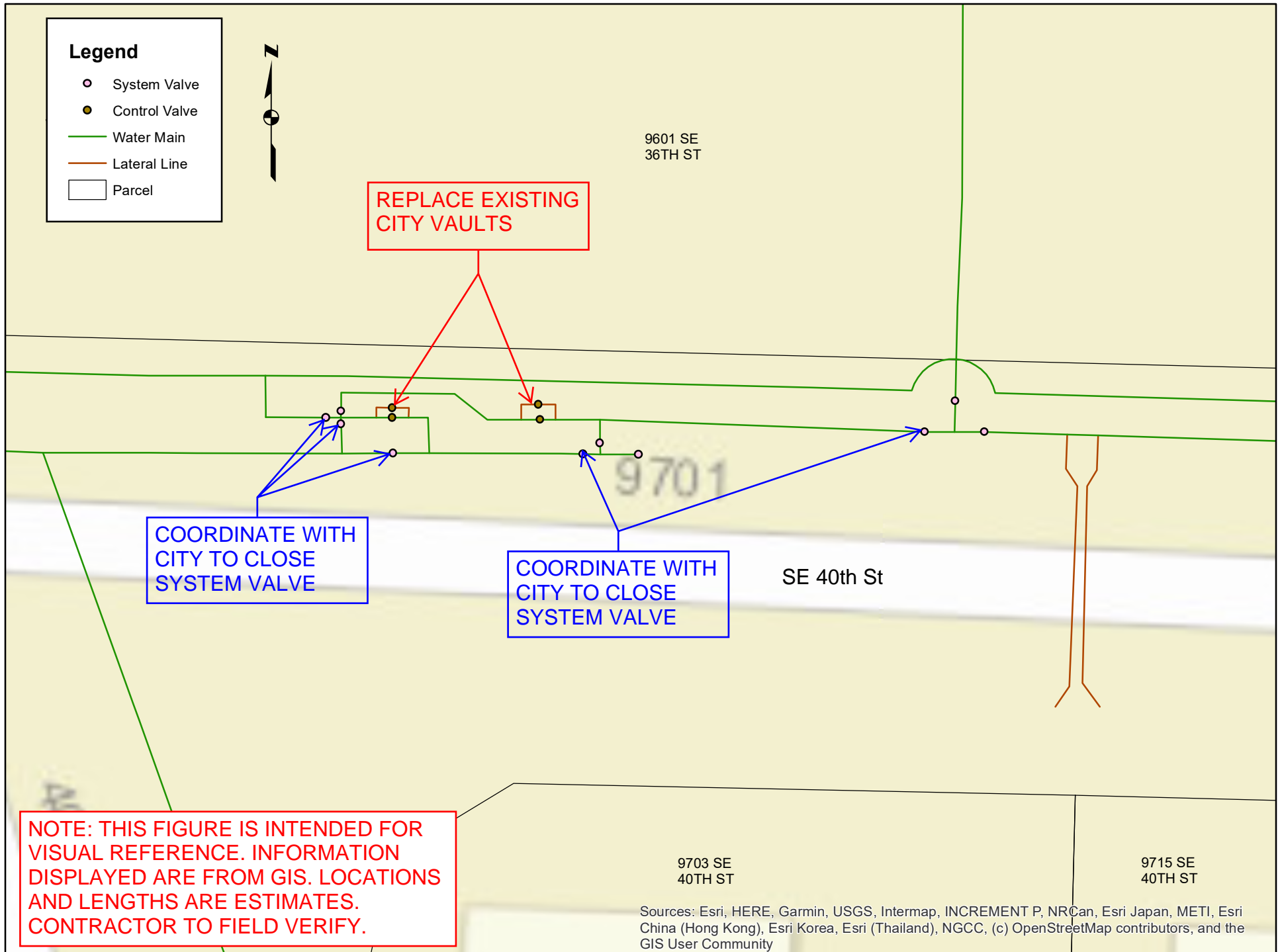
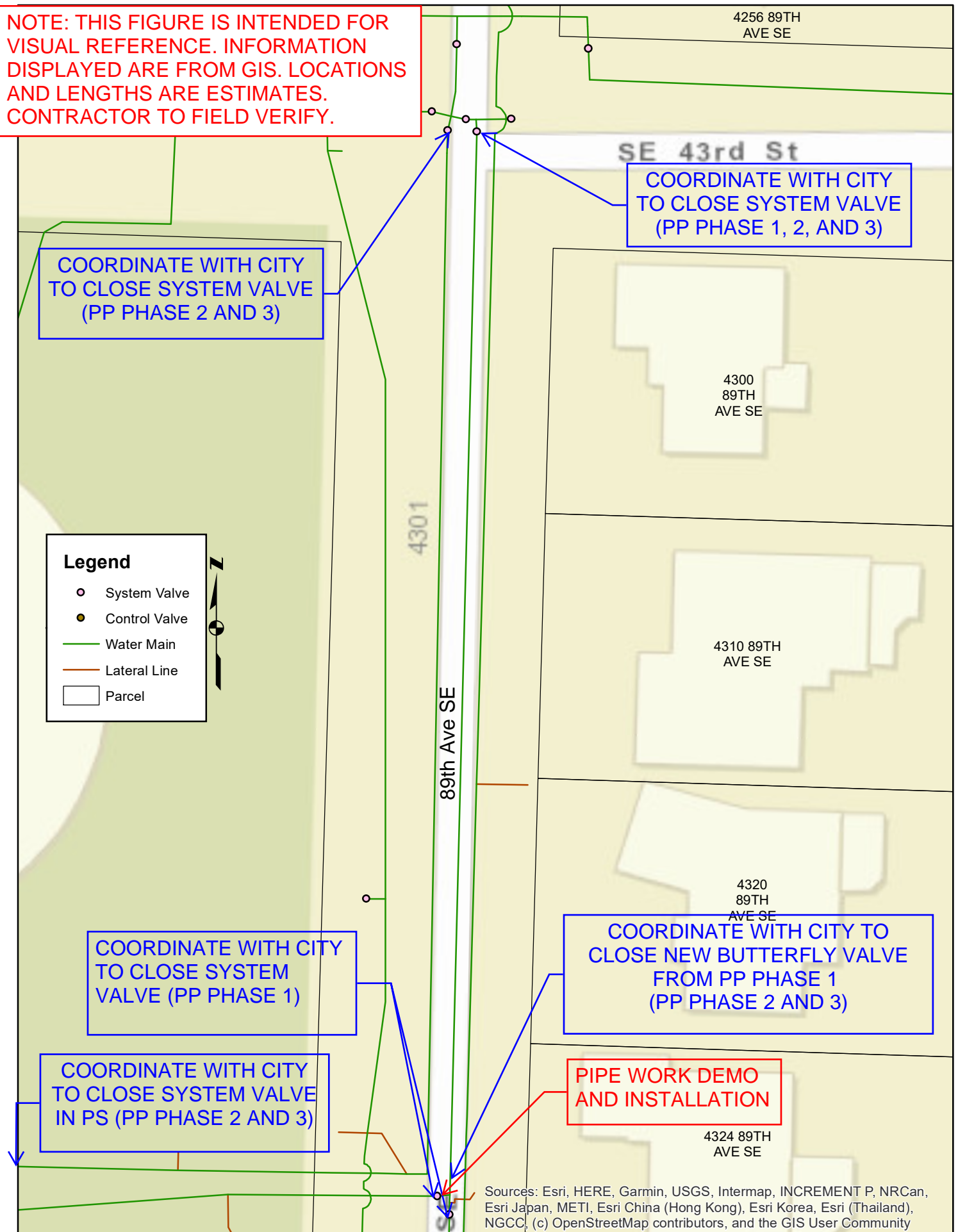


Figure 4 - New PRV and Meter Vaults at SE 40th ST

NOTE: THIS FIGURE IS INTENDED FOR VISUAL REFERENCE. INFORMATION DISPLAYED ARE FROM GIS. LOCATIONS AND LENGTHS ARE ESTIMATES. CONTRACTOR TO FIELD VERIFY.



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Figure 5 - 89th AVE SE Pipe Work

APPENDIX B
“Method of Procedure” (MOP)
Instructions and Forms

Definition and Purpose

“Method of Procedure” (MOP) is a detailed document submitted by the Contractor to request process shutdown(s), utility tie-in(s), work in areas that may risk unanticipated outages, or flow diversions to accommodate site construction activities during a project. Such activities may include (but are not limited to) new tie-ins to utilities or structures, mechanical modifications to process piping or equipment, demolition, bulkhead installation, and cleaning processes.

The MOP provides a detailed plan to the Owner and Engineer that describes specific aspects of the work including purpose, time of execution, and anticipated impacts on treatment processes. The MOP also includes contingency measures and provisions for rapid closure in the event that shutdown or work progress difficulties are encountered. Information from relevant trades associated with the requested shutdown, diversion, or tie-in is also included.

The Owner should use the information within the MOP to define operational procedures and methods to safely and successfully assist the Contractor.

MOP Process Summary

WHO	STEP	TIMING
Contractor	1. Identify MOPs needed on MOP Log and Baseline Schedule.	No later than 7 days prior to Preconstruction Scheduling Meeting
Contractor, Owner, Engineer	2. Pre-MOP Meeting.	More than 28 days prior to work
Contractor	3. Submits MOP.	No later than 28 days prior to work
Owner	4. Reviews MOP.	
Owner	5. MOP finalized.	No later than 7 days prior to work
Contractor	6. Complete Readiness Checklist.	No later than 5 days prior to work
Contractor	7. Complete Safety Checklist.	Immediately prior to commencing work
Contractor	8. Complete Work.	
Contractor	9. Update MOP Log and Progress Schedules.	Monthly

MOP Process Detail

STEP 1. Identifies MOPs needed on MOP Log and Baseline Schedule.

Contractor submits a preliminary list of anticipated project MOPs on MOP Log. MOPs identified but not limited to those shutdowns, diversions, or tie-ins described in the Contract Documents. Incorporate MOPs as tasks in Baseline Schedule. Date scheduled MOPs to coincide with the appropriate construction activities.

STEP 2. Pre-MOP Meeting.

Contractor requests a Pre-MOP Meeting with the Owner and Engineer to discuss the nature of the shutdown, diversion, or tie-in, and to gather the information necessary to complete the MOP Form. The pre-MOP meeting may be waived by the Owner or Engineer if the work is deemed to be minor.

STEP 3. Submits MOP.

Contractor completes the MOP Form and submit 3 copies for approval to the Owner's Project Manager (OPM).

STEP 4. Reviews MOP.

OPM distributes MOP Form for review by the Owner's Construction Coordinator, O&M Representative, and Engineer's Project Representative. Review MOP Form for completeness, accuracy, compliance with both the construction schedule, constraints defined in contract documents, and to ensure that the requested work does not negatively impact pump station operations or other concurrent project activities. Additional information may be requested to better understand the nature of and method for completing the Work.

STEP 5. MOP finalized.

Once the MOP is agreed to by all parties, the MOP will be finalized by signature. Copies are distributed to the Owner, Engineer, and Contractor.

STEP 6. Complete Readiness Checklist.

Contractor verifies everything is ready for the work.

STEP 7. Complete Safety Checklist.

Contractor ensures safety.

STEP 8. Complete work.

Contractor complete work.

STEP 9. Update MOP Log and Progress Schedules.

Contractor updates MOP Log weekly and distributes at the regularly scheduled construction progress meetings.



METHOD OF PROCEDURE (MOP) FORM

Owner: _____ **Date:** _____
Contractor: _____ **Carollo Project No.:** _____
Project Name: _____ **Submittal No.:** _____
Submittal Title: _____ **Spec/Dwg. Reference:** _____

MOP #	Task Title (<i>Provide <10 word title</i>):	Submittal Date: (<i>No later than 28 days prior to work</i>)
-------	--	--

SCHEDULE OF WORK ACTIVITY START: (*Date/Time*) _____ END: (*Date/Time*) _____

REQUESTOR: _____

PRIMARY POINT OF CONTACT: _____ PHONE/PAGER: _____

SECONDARY POINT OF CONTACT: _____ PHONE/PAGER: _____

NOTIFY Control Room, Phone Security, Phone

BUILDING: _____ LOCATION OF WORK FLOOR/LEVEL: _____

DESCRIPTION OF WORK: (*Provide sufficient details on process isolation, work sequencing, and safety (i.e., control of significant hazards unique to the work) to demonstrate an understanding of the work and how it will be completed within the constraints, and its impact on the processes and facility.*)

Task Summary: _____

Processes Affected: _____

Trades Affected: _____

WORK PLAN:

Work Sequencing: _____

Process Isolation: _____

Spill Prevention Plan: _____

Contingency Plans: _____

CRITICAL EQUIPMENT/TOOLS: (*pumps and discharge hoses with correct fittings, blind flanges and pipe plugs, no-hub fittings, properly sized electrical service components, generators, portable lighting, chlorine for potable water pipe breaks, etc.*)

<input type="checkbox"/>	Acoustic Ceiling/or Walls Access	<input type="checkbox"/>	Excavation Permit	<input type="checkbox"/>	Lock Out/Tag Out
<input type="checkbox"/>	Chemical Use Approval	<input type="checkbox"/>	Fire Sprinkler Impairment	<input type="checkbox"/>	Life Safety Systems
<input type="checkbox"/>	Confined Space Permit	<input type="checkbox"/>	Flammable Materials	<input type="checkbox"/>	Roof Protocol
<input type="checkbox"/>	Critical Lift Plan	<input type="checkbox"/>	Flush / Discharge	<input type="checkbox"/>	Work After Dark
<input type="checkbox"/>	Energized Electrical Work	<input type="checkbox"/>	High Pressure Test	<input type="checkbox"/>	
<input type="checkbox"/>	Elect. Panel Schedules	<input type="checkbox"/>	Hot Work/Open Flame	<input type="checkbox"/>	

EXISTING SERVICE(S) AT RISK:

<input type="checkbox"/>	Breathing Air	<input type="checkbox"/>	Elect Normal	<input type="checkbox"/>	Process Access	<input type="checkbox"/>	Telephones
<input type="checkbox"/>	Chemical Distribution	<input type="checkbox"/>	Fire Protection	<input type="checkbox"/>	Safety Showers	<input type="checkbox"/>	UPS
<input type="checkbox"/>	City Water	<input type="checkbox"/>	HVAC	<input type="checkbox"/>	SCADA	<input type="checkbox"/>	VAX/DATA
<input type="checkbox"/>	Communication	<input type="checkbox"/>	Inert Gas	<input type="checkbox"/>	Security	<input type="checkbox"/>	
<input type="checkbox"/>	Domestic Drain	<input type="checkbox"/>	Instrument - Air	<input type="checkbox"/>	Solvent Drain	<input type="checkbox"/>	
<input type="checkbox"/>	Elect-Bus Duct	<input type="checkbox"/>	Life Safety System	<input type="checkbox"/>	Specialty Gases	<input type="checkbox"/>	

Work Restrictions

01_14_00-15

pw://Carollo/Documents/Client/WA/Mercer Island/11540C10/Specifications/01_14_00 (FS)

11540C10

May 2021

<input type="checkbox"/>	Elect Emergency	<input type="checkbox"/>	Natural Gas	<input type="checkbox"/>	Storm Drain	<input type="checkbox"/>	
REVIEWER'S INSTRUCTIONS / COMMENTS:							

<input type="checkbox"/>	PRE-JOB BRIEFING MUST BE COMPLETED PRIOR TO COMMENCING WORK:						
	Full Name (printed)	Signature	Phone	Date			
Submitted By							
System Owner							
Reviewer (if needed)							
Reviewer (if needed)							
Reviewer (if needed)							
Reviewer (if needed)							

READINESS CHECKLIST
(5 days prior to work)

Checklist provided as a guide but is not all inclusive.

1. Confirm all parts and materials are on site: _____

2. Review work plan: _____

3. Review contingency plan: _____

SAFETY CHECKLIST
(Just prior to commencing work)

Checklist provided as a guide but is not all inclusive.

1. Location awareness:
 - a. Emergency exits: _____
 - b. Emergency shower and eyewash: _____
 - c. Telephones and phone numbers: _____
 - d. Shut-off valve: _____
 - e. Electrical disconnects: _____
2. Inspect work area:
 - a. Take time to survey the area you are working in. Ensure that what you want to do will work. Do you have enough clearance? Is your footing secure? Do you have adequate lighting and ventilation? Are surrounding utilities out of the way for you to perform your work?
3. SDS (Safety Data Sheets):
 - a. Understand the chemicals and substances in the area you are working in by reading the SDS.
4. Lockout/Tagout Procedure:
 - a. Lockout/tagout energy sources before beginning work.
 - b. Make sure all valves associated with the work are locked out and tagged out on each side of the penetration.
 - c. Make sure the lines are depressurized.
5. Overhead work:
 - a. Use appropriate personal protective equipment; i.e., safety harness, lifeline, etc.
 - b. Select appropriate tie-off points; i.e., structurally adequate, not a pipe or conduit, etc.
 - c. Spotter assigned and in position.
 - d. Pipe rack access; i.e., check design capacity, protective decking or scaffolding in place, exposed valves or electrical switches identified and protected.
6. Safety equipment:
 - a. Shepherd's hook.
 - b. ARC flash protection.
 - c. Fire extinguisher.
 - d. Other: _____
7. Accidents:
 - a. Should accidents occur, do not shut off and do not attempt to correct the situation, unless you are absolutely positive that your action will correct the problem and not adversely affect other people or equipment.
8. Review process start-up documents:
 - a. In the event the system is shutdown, the Control Center should have a working knowledge of the process start-up procedures in order to deal effectively with unforeseen events.
9. Evacuation procedures:
 - a. Do not obstruct evacuation routes.
 - b. Take time to survey the area for evacuation routes.

Method of Procedure (MOP) Log
Sample

MOP Number	Task Title	Date Requested	Date Approved	Date Work Planned	Work Completed (yes/no)
001					
002					
003					

SECTION 01_31_19

PROJECT MEETINGS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements for conducting conferences and meetings for the purposes of addressing issues related to the Work, reviewing and coordinating progress of the Work and other matters of common interest, and includes the following:
1. Qualifications of Meeting Participants.
 2. Pre-construction Conference.
 3. Progress Meetings.
 4. Pre-Installation Meetings.
 5. Schedule Update Meetings.
 6. Quality Control Meetings.
 7. Pre-Shutdown Meetings.
 8. Pre-Process Start-up Meetings.
 9. Electrical and Instrumentation Coordination Meetings.
 10. Close-out meeting.
 11. Post Construction Meeting.

1.02 QUALIFICATIONS OF MEETING PARTICIPANTS

- A. Representatives of entities participating in meetings shall be qualified and authorized to act on behalf of entity each represents.

1.03 PRE-CONSTRUCTION CONFERENCE

- A. Upon issuance of Notice to Proceed, or earlier when mutually agreeable, Engineer will arrange pre-construction conference in place convenient for most invitees.
- B. Pre-construction Conference invitees: Contractor's project manager and superintendent, Owner, Engineer, representatives of utilities, major subcontractors and others involved in performance of the Work, and others necessary to agenda.
- C. Engineer will preside at conference.
- D. Purpose of conference: To establish working understanding between parties and to discuss Construction Schedule, shop drawing and other submittals, cost breakdown of major lump sum items, processing of submittals and applications for payment, and other subjects pertinent to execution of the Work.
- E. Agenda will include:
1. Adequacy of distribution of Contract Documents.
 2. Distribution and discussion of list of major subcontractors and suppliers.
 3. Proposed progress schedules and critical construction sequencing.
 4. Major equipment deliveries and priorities.
 5. Project coordination.

6. Designation of responsible personnel.
 7. Procedures and processing of:
 - a. Field decisions.
 - b. Proposal requests.
 - c. Submittals.
 - d. Change Orders.
 - e. Request for Information/Interpretations.
 - f. Applications for Payment.
 - g. Record Documents.
 8. Use of premises:
 - a. Office, construction, and storage areas.
 - b. Owner's requirements.
 9. Construction facilities, controls, and construction aids.
 10. Temporary utilities.
 11. Safety and first aid procedures.
 12. Security procedures.
 13. Housekeeping procedures.
- F. Engineer will record minutes of meeting and distribute copies of minutes within 7 days of meeting to participants and interested parties.

1.04 PROGRESS MEETINGS

- A. Engineer will schedule and administer meetings throughout progress of the Work at maximum weekly intervals.
- B. Engineer will make arrangements for meetings, prepare agenda with copies for participants and preside at meeting.
- C. Attendance required: Owner, Engineer, Contractor, Contractor's Project Manager, superintendent, quality control manager, project scheduler, major subcontractors and suppliers as appropriate to agenda topics for each meeting.
- D. Additional invitees: Owner utility companies when the Work affects their interests, and others necessary to agenda.
- E. Agenda:
 1. Review minutes of previous meeting/minutes.
 2. Safety and security.
 3. Schedule Status:
 - a. Construction schedule summary (Actual Progress and Variance):
 - 1) "Activities Started/Completed" this period.
 - 2) "Activities Started/Completed" "Variance" Baseline vs. current.
 - 3) "Added/Deleted Activities".
 - 4) "Revised Activity Descriptions".
 - 5) Any significant Proposed Logic Changes.
 - b. Review milestone "Substantial Completion" Schedule.
 - c. Review "Budgeted Cost" indicating the Current Project Budgeted Cost.
 - d. Review of 6 weeks schedule.
 4. Review of off-site fabrication and delivery schedules.
 5. Review of submittals schedule and status of submittals.
 6. Request for information (RFI) status.
 7. MOP's/shutdown coordination.

8. Maintenance of quality standards (QA/QC):
 - a. Review of out-of-compliance inspection or test results.
 - b. Field observations, problems, and decisions.
 - c. Coordination of required inspections and tests.
 - d. Maintenance of quality and work standards.
 9. Change order management status.
 10. Commissioning and process start-up.
 11. General Items.
 12. Action items.
 13. Next meeting.
- F. Engineer will record minutes and distribute copies within 5 calendar days after meeting to participants, with copies to Contractor, Owner, and those affected by decisions made.

1.05 PRE-INSTALLATION MEETINGS

- A. Pre-Installation Meeting shall be held prior to installation of OSHG equipment.
- B. As required above or in individual specification sections or requested by Engineer, convene pre-installation meeting at Project site before commencing work of specific section.
- C. Require attendance of parties directly affecting, or affected by, Work of specific section.
- D. Notify Engineer no later than 7 calendar days in advance of meeting date.
- E. Prepare agenda and preside at meeting:
 1. Review conditions of installation, preparation and installation procedures.
 2. Review coordination with related work.
- F. Contractor will record minutes and distribute electronic copies within 7 calendar days after meeting to participants, with copies to Engineer, Owner, and those affected by decisions made.

1.06 PRE-SHUTDOWN MEETINGS

- A. Follow Owner's standard Construction Method of Procedure (MOP). See Appendix B of Section 01_14_00 - Work Restrictions for MOP format.
- B. All short-term and longer-term shutdowns and other tie-ins that require an Owner approved MOP also require a pre-shutdown meeting at Project site prior to commencing shutdown for tie-in or modification.
- C. Require attendance of parties directly affecting, or affected by shutdown, including Engineer, specific work crews, Owner's construction, operations, and maintenance staff.
- D. Notify Engineer no later than 7 calendar days in advance of meeting date.

- E. Prepare agenda and preside at meeting:
 - 1. Review accepted MOP including conditions of shutdown, preparation, and installation procedures.
 - 2. Review timelines and sequences.
 - 3. Review responsibilities.
 - 4. Review dry run plan and schedule, as necessary.
 - 5. Review coordination with related work.
- F. Contractor will record minutes and distribute copies within 5 calendar days after meeting and prior to scheduled shutdown to participants, with copies to Engineer, Owner, and those affected by decisions made.

1.07 COMMISSIONING COORDINATION MEETINGS

- A. All processes and equipment that requires testing and process start-up also requires a pre-startup meeting at Project site before commencing process start-up of specific plant systems.
- B. Require attendance of parties directly affecting, or affected by process start-up and testing, including Engineer, Commissioning Coordinator, specific work crews, Owner's construction operations, and maintenance staff.
- C. Notify Engineer no later than 7 calendar days in advance of meeting date.
- D. Prepare agenda:
 - 1. As specified in Section 01_75_17 - Commissioning.
 - 2. Review accepted Construction Method of Procedure (MOP).
 - 3. Owner make final decision for GO or NO GO.
- E. Preside at meeting.
- F. Contractor will record minutes and distribute electronic copies within 5 calendar days after meeting and prior to scheduled process start-up to participants, with copies to Engineer, Owner, and those affected by decisions made:
 - 1. Follow Owner's standard Construction Method of Procedure (MOP). See Appendix B of Section 01_14_00 - Work Restrictions for MOP format.

1.08 ELECTRICAL AND INSTRUMENTATION COORDINATION MEETINGS

- A. Electrical Meetings:
 - 1. Pre-submittal review meeting as specified in Section 26_00_00 - Electrical General.
 - 2. Other meetings as required and as otherwise specified.

1.09 CLOSE-OUT MEETING

- A. Engineer will schedule close-out meeting.
- B. Engineer will make arrangements for meeting, prepare agenda with copies for participants, and preside at meeting.
- C. Attendance required: Owner, Engineer, Contractor, Contractor's Project Manager, and Superintendent.

- D. Agenda:
 - 1. Review punch list completion.
 - 2. Transfer of record documents.
 - 3. Finalize payment.
- E. Engineer will record minutes and within 5 calendar days after meeting distribute copies to participants.

1.10 POST CONSTRUCTION MEETING

- A. Meet with and inspect the Work 11 months after date of Substantial Completion with Owner and Engineer.
- B. Owner will arrange meeting at least 7 days before meeting.
- C. Meet in Owner's office or other mutually agreed upon place.
- D. Inspect the Work and draft list of items to be completed or corrected.
- E. Review service and maintenance contracts and take appropriate corrective action when necessary.
- F. Complete or correct defective work and extend correction period accordingly.
- G. Require attendance of Contractor, Project Manager, or Superintendent, appropriate manufacturers and installers of major units of constructions, and affected subcontractors.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01_32_21

SCHEDULES AND REPORTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Preparation, submittal, and maintenance of schedules and reports.
- B. This Section is supplementary to City of Mercer Island General Terms and Conditions Article 4.4.

1.02 SUBMITTAL REQUIREMENTS

- A. Submit preliminary and baseline schedule.
- B. Submit preliminary and baseline schedule of values.
- C. Submit preliminary and baseline schedule of submittals.
- D. Submit, on a monthly basis, updated schedules as specified.
- E. Submit final schedule update as specified.
- F. Submit revised schedules and time impact analyses as specified.
- G. Submit schedules in the media and number of copies as follows:
 - 1. Provide each submittal in PDF format and in other formats specified in this Section.

1.03 SCHEDULER

- A. Designate, in writing and within 5 calendar days after Notice of Award, the person responsible for preparation, maintenance, updating, and revision of all schedules.
- B. Qualifications of scheduler:
 - 1. Authority to act on behalf of Contractor.
 - 2. A minimum of 5 years verifiable experience in preparation of construction schedules for projects of similar value, size, and complexity.
 - 3. Knowledge of critical path method (CPM) scheduling utilizing Microsoft Project software.
- C. Owner reserves the right to disapprove scheduler when submitted by Contractor if not qualified.
- D. Owner reserves the right to remove scheduler from the project if found to be unqualified.

1.04 PRECONSTRUCTION SCHEDULING MEETING

- A. Engineer will conduct Preconstruction Scheduling Meeting with Contractor's Project Manager, General Superintendent, and scheduler within 7 calendar days after Notice to Proceed:
 - 1. This meeting is separate from the Preconstruction Conference Meeting and is intended to exclusively cover schedule issues.
- B. At the meeting, review scheduling requirements:
 - 1. These include schedule preparation, reporting requirements, labor and equipment loading, updates, revisions, and schedule delay analysis.
 - 2. Present schedule methodology, planned sequence of operations, cost and resource loading methodology, and proposed activity coding structure.
 - 3. Naming convention: Name schedule files with the year, month and day of the data date, revision identifier, and a description of the schedule:
 - a. Example 1: 2020_07_30 rev 1 draft baseline schedule.xer.
 - b. Example 2: 2020_09_30 rev 2 sep final update.xer.

1.05 REVIEW AND ACCEPTANCE OF SCHEDULES

- A. Engineer will review Baseline Schedule, Schedule Updates, Schedule Revisions and Time Impact Analyses to ascertain compliance with specified project constraints, compliance with milestone dates, reasonableness of durations and sequence, accurate inter-relationships, and completeness.
- B. Engineer and Owner will issue written comments following completion of review of Baseline Schedule within 21 calendar days after receipt.
- C. Written comments on review of Schedule Updates and Schedule Revisions and Time Impact Analyses will be returned to Contractor within 14 calendar days after receipt by Engineer.
- D. Revise and resubmit schedule in accordance with Engineer's comments within 7 calendar days after receipt of such comments or request joint meeting to resolve objections.
- E. If Engineer requests a meeting, the Contractor and all major subcontractors must participate in the meeting with Engineer:
 - 1. Revise and resubmit schedule within 7 calendar days after meeting.
- F. Use accepted schedule for planning, organizing, and directing the work and for reporting progress.
- G. Engineer's submittal review response:
 - 1. When schedule reflects Owner's and Contractor's agreement of project approach and sequence, schedule will be accepted by Owner.
 - 2. Engineer's submittal review response for schedule submittal will be "Receipt Acknowledged - Filed for Record" including applicable comments.
 - 3. Acceptance of the schedules by the Owner is for general conformance with the Contract Documents and for Owner's planning information, and does not relieve the Contractor of sole responsibility for planning, coordinating, and executing the Work within the contract completion dates. Omissions and errors in the accepted schedules shall not excuse performance less than that

required by the Contract Documents. Acceptance by the Owner in no way constitutes an evaluation or validation of the Contractor's plan, sequence or means, methods, and techniques of construction.

1.06 SCHEDULE UPDATES

A. Any update:

1. Prepare update using most recent accepted version of schedule including:
 - a. Actual start dates of activities that have been started.
 - b. Actual finish dates of activities that have been completed.
 - c. Percentage of completion of activities that have been started but not finished.
 - d. Actual dates on which milestones were achieved.
 - e. Update activities by inputting percent complete figures with actual dates.
 - f. Use retained logic in preparing Schedule Updates.
 - g. When necessary, input remaining durations for activities whose finish dates cannot be calculated accurately with a percent complete figure only.
 - h. Revisions to the schedule may be included that have been previously approved as specified in this Section under Revisions to Schedule.

B. Monthly updates:

1. Submit written narrative report in conjunction with each Schedule Update including descriptions of the following:
 - a. Activities added to or deleted from the schedule are to adhere to cost and other resource loading requirements:
 - 1) Identify added activities in manner distinctly different from original activity designations.
 - b. Changes in sequence or estimated duration of activities.
 - c. Current or anticipated problems and delays affecting progress, impact of these problems and delays and measures taken to mitigate impact.
 - d. Assumptions made and activities affected by incorporating change order work into the schedule.
2. Submit updated schedule and materials specified under Submittal of Progress Schedules, 5 calendar days before the monthly schedule update meeting.
3. Since Monthly Schedule Update is the application for progress payment required, submittal and acceptance of the monthly Schedule Update is a condition precedent to the making of any progress payments.

C. Weekly progress meeting:

1. Update the schedule prior to weekly progress meeting:
 - a. Identify overall progress of each Major Item of Work in the Summary Schedule.
 - b. If there are significant changes to the schedule, submit a written report at the weekly progress meeting.
2. Should monthly Schedule Update show project completion earlier than current Contract completion date, show early completion time as schedule activity, identified as "Project Float".
3. Should monthly Schedule Update show project completion later than current Contract completion date, prepare and submit a Schedule Revision in accordance with the Revisions to Schedule.

1.07 REVISIONS TO SCHEDULE

- A. Submit Revised Schedule within 5 days:
 - 1. When delay in completion of any activity or group of activities indicates an overrun of the Contract Time or milestone dates by 20 working days or 5 percent of the remaining duration, whichever is less.
 - 2. When delays in submittals, deliveries, or work stoppages are encountered making necessary the replanning or rescheduling of activities.
 - 3. When the schedule does not represent the actual progress of activities.
 - 4. When any change to the sequence of activities, the completion date for major portions of the work, or when changes occur which affect the critical path.
 - 5. When Contract modification necessitates schedule revision, submit schedule analysis of change order work with cost proposal.
- B. Create a separate submittal for Schedule Revisions:
 - 1. Comply with schedule updates as specified in this Section.
 - 2. Do not submit with Schedule Updates.
- C. Schedule Revisions will not be reflected in the schedule until after the revision is accepted by the Owner:
 - 1. This includes Schedule Revisions submitted for the purpose of mitigating a Contractor-caused project delay (Recovery Schedule).

1.08 ADJUSTMENT OF CONTRACT TIMES

- A. Contract Time will be adjusted only for causes specified in Contract Documents:
 - 1. Non-excusable delay:
 - a. Non-excusable delays include actions or inactions of the Contractor, or events for which the Contractor has assumed contractual responsibility (including actions or inactions of subcontractors, suppliers, or material manufacturers at any tier) that would independently delay the completion of the Work beyond the current Contract completion date).
 - b. No time extensions will be granted for non-excusable delays.
 - 2. Excusable delay:
 - a. Events which are unforeseeable, outside the control of, and without the fault or negligence of either the Owner or the Contractor (or any party for whom either is responsible), which would independently delay the completion of the Work beyond the current Contract completion date.
 - b. The Contractor is entitled to a time extension only.
 - c. No other damages will be approved.
 - 3. Compensable delay:
 - a. Actions or inactions of the Owner, or events for which the Owner has assumed contractual responsibility, which would independently delay the completion of the Work beyond the current Contract completion date.
 - b. The Contractor is entitled to a time extension and delay damages.
 - 4. Concurrent delay:
 - a. Concurrent delay is any combination of the above 3 types of delay occurring on the same calendar date.
 - b. Exception to concurrent delay: Cases where the combination consists of 2 or more instances of the same type of delay occurring on the same calendar date. When one cause of delay is Owner-caused or caused by an event which is beyond the control and without the fault or negligence of

either the Owner or the Contractor and the other Contractor-caused, the Contractor is entitled only to a time extension and no delay damages.

- B. If the Contractor believes that the Owner has impacted its work, such that the project completion date will be delayed, the Contractor must submit proof demonstrating the delay to the critical path:
 - 1. This proof, in the form of a Time Impact Analysis, may entitle the Contractor to an adjustment of Contract Time.
- C. Time Impact Analysis:
 - 1. Use the accepted schedule update that is current relative to the time frame of the delay event (change order, third party delay, or other Owner-caused delay). Represent the delay event in the schedule by:
 - a. Inserting new activities associated with the delay event into the schedule.
 - b. Revising activity logic.
 - c. Revising activity durations.
 - 2. If the project schedule's critical path and completion date are impacted as a result of adding this delay event to the schedule, a time extension equal to the magnitude of the impact may be warranted.
 - 3. The Time Impact Analysis submittal must include the following information:
 - a. A fragment of the portion of the schedule affected by the delay event.
 - b. A narrative explanation of the delay issue and how it impacted the schedule.
 - c. A schedule file used to perform the Time Impact Analysis.
- D. When a delay to the project as a whole can be avoided by revising preferential sequencing or logic, and the Contractor chooses not to implement the revisions, the Contractor will be entitled to a time extension and no compensation for extended overhead.
- E. Indicate clearly that the Contractor has used, in full, all project float available for the work involved in the request, including any float that may exist between the Contractor's planned completion date and the Contract completion date:
 - 1. Utilize the latest version of the Schedule Update accepted at the time of the alleged delay, and all other relevant information, to determine the adjustment of the Contract Time.
- F. Adjustment of the Contract Times will be granted only when the Contract Float has been fully utilized and only when the revised date of completion of the Work has been pushed beyond the Contract completion date:
 - 1. Adjustment of the Contract Times will be made only for the number of days that the planned completion of the work has been extended.
- G. Actual delays in activities which do not affect the critical path work or which do not move the Contractor's planned completion date beyond the Contract completion date will not be the basis for an adjustment to the Contract Time.
- H. If completion of the project occurs within the specified Contract Time, the Contractor is not entitled to job-site or home office overhead beyond the Contractor's originally planned occupancy of the site.
- I. Notify Engineer of a request for Contract Time adjustment:
 - 1. Submit request as specified with Contract Documents.

2. In cases where the Contractor does not submit a request for Contract Time adjustment for a specific change order, delay, or Contractor request within the specified period of time, then it is mutually agreed that the particular change order, delay, or Contractor request has no time impact on the Contract completion date and no time extension is required.
- J. The Engineer will, within 30 calendar days after receipt of a Contract Time adjustment, request any supporting evidence, review the facts, and advise the Contractor in writing:
1. Include the new Progress Schedule data, if accepted by the Owner, in the next monthly Schedule Update.
 2. When the Owner has not yet made a final determination as to the adjustment of the Contract Time, and the parties are unable to agree as to the amount of the adjustment to be reflected in the Progress Schedule, reflect that amount of time adjustment in the Progress Schedule as the Engineer may accept as appropriate for such interim purpose.
 3. It is understood and agreed that any such interim acceptance by the Engineer shall not be binding and shall be made only for the purpose of continuing to schedule the Work, until such time as a final determination as to any adjustment of the Contract Time acceptable to the Engineer has been made.
 4. Revise the Progress Schedule prepared thereafter in accordance with the final decision.

1.09 SCHEDULE PREPARATION

- A. Preparation and submittal of Progress Schedule represents Contractor's intention to execute the Work within specified time and constraints:
1. Failure to conform to requirement may result in termination for cause.
- B. Contractor's bid covers all costs associated with the execution of the Work in accordance with the Progress Schedule.
- C. During preparation of the preliminary Progress Schedule, Engineer will facilitate Contractor's efforts by being available to answer questions regarding sequencing issues, scheduling constraints, interface points, and dependency relationships.
- D. Prepare schedule utilizing Precedence Diagramming Method (PDM).
- E. Prepare schedule utilizing activity durations in terms of working days:
1. Do not exceed 15 working day duration on activities except concrete curing, submittal review, and equipment fabrication and deliveries.
 2. Where duration of continuous work exceeds 15 working days, subdivide activities by location, stationing, or other sub-element of the Work.
 3. Coordinate holidays to be observed with the Owner and incorporate them into the schedule as non-working days.
- F. Failure to include an activity required for execution of the Work does not excuse Contractor from completing the Work and portions thereof within specified times and at price specified in Contract:
1. Contract requirements are not waived by failure of Contractor to include required schedule constraints, sequences, or milestones in schedule.
 2. Contract requirements are not waived by Owner's acceptance of the schedule. In event of conflict between accepted schedule and Contract requirements,

terms of Contract govern at all times, unless requirements are waived in writing by the Owner.

- G. Reference schedule to working days with beginning of Contract Time as Day "1".
- H. Baseline Schedule and Project Completion:
 - 1. Should Contractor submit a Baseline Schedule showing project completion more than 20 working days prior to Contract completion date, Owner may issue Change Order, at no cost to Owner, revising time of performance of Work and Contract completion date to match Contractor's schedule completion date.
 - 2. Adjust accordingly any Contract milestone dates.
- I. Imposed dates, hidden logic prohibited: Do not use imposed dates or hidden logic in preparation of schedule.
- J. Interim milestone dates, operational constraints:
 - 1. In event there are interim milestone dates and/or operational constraints set forth in Contract, show them on schedule.
 - 2. Do not use Zero Total Float constraint or Mandatory Finish Date on such Contract requirements.

1.10 NETWORK DETAILS AND GRAPHICAL OUTPUT

- A. Produce a clear, legible, and accurate calendar based, time scaled, and graphical network diagram:
 - 1. Group activities related to the same physical areas of the Work. Produce the network diagram based upon the early start of all activities.
- B. Include for each activity, the description, activity number, estimated duration in working days, total float, and all activity relationship lines.
- C. Illustrate order and interdependence of activities and sequence in which Work is planned to be accomplished:
 - 1. Incorporate the basic concept of the precedence diagram network method to show how the start of 1 activity is dependent upon the start or completion of preceding activities and its completion restricts the start of following activities.
- D. Indicate the critical path for the project.
- E. Delineate the specified contract duration and identify the planned completion of the Work as a milestone:
 - 1. Show the time period between the planned and Contract completion dates, if any, as an activity identified as project float unless a Change Order is issued to officially change the Contract completion date.
- F. Identify system shutdown dates, system tie-in dates, specified interim completion or milestone dates and contract completion date as milestones.
- G. Include, in addition to construction activities:
 - 1. Submission dates and review periods for major equipment submittals and shoring submittals:
 - a. Shoring reviews: Allow 4-week review period for each shoring submittal.

2. Any activity by the Owner or the Engineer that may affect progress or required completion dates.
 3. Equipment and long-lead material deliveries over 8 weeks.
 4. Approvals required by regulatory agencies or other third parties.
- H. Produce network diagram on 22-inch by 34-inch sheets with grid coordinate system on the border of all sheets utilizing alpha and numeric designations.

1.11 WEATHER DAY ALLOWANCE

- A. Definition:
1. Weather conditions that prevent or inhibit the Contractor's performance of the Work and affect the Critical Path indicated on the Schedule shall be referred to as a Weather Day.
 2. A Weather Day is defined as the Contractor being unable to perform at least 4 hours of work on the Critical Path.
- B. Allowance:
1. Include as a separate identifiable activity on the critical path, an activity labeled "Weather Days Allowance".
- C. Actual weather day:
1. Insert a weather delay activity in critical path to reflect actual weather day occurrences when weather days are experienced and accepted by Engineer.
 2. Reduce duration of Weather Days Allowance activity as weather delays are experienced and inserted into the Schedule. Remaining weather days in Weather Day Allowance at completion of project is considered float.
 3. The Contractor shall provide a written notice to the Engineer of the occurrence of a weather day within 2 days after the onset of such weather and shall describe in reasonable detail the type of weather encountered and the Work interfered with or interrupted:
 - a. A schedule update will not suffice as a written notice.
 - b. The Engineer will determine if the weather day constitutes a use of a portion of the Weather Day Allowance.
 - c. After use of all the Weather Day Allowance, the Engineer will determine if the Contractor is entitled to an extension of the Contract Time due to weather conditions.
 - d. Weather days are considered excusable delay as defined in this Section.

1.12 SCHEDULE OF SUBMITTALS

- A. Schedule of Submittals shall include submittals required in the Contract Documents but not limited to Commissioning Plans, Training Plans, test procedures, operation and maintenance manuals, shop drawings, samples, record documents, and specifically required certificates, warranties, and service agreements.
- B. Preliminary Schedule of Submittals:
1. Due date: After Preliminary Schedule has been submitted and accepted by Owner.
 2. Format:
 - a. Include submittals anticipated in the first 90 calendar days after Notice to Proceed using early start dates.
 - b. Indicate week and month anticipated for each submittal.

- c. Indicate "Priority" submittals where review time can impact Contractor's schedule:
 - 1) "Priority" indication will not alter review times specified in Section 01_33_00 - Submittal Procedures.
 - 2) Engineer will endeavor to provide early review of "Priority" submittals where possible.
- 3. Submittal of Preliminary Schedule of Submittals shall be a condition precedent to Owner making progress payments during the first 90 calendar days after Notice to Proceed.

C. Final Schedule of Submittals:

- 1. Due date: After Baseline Schedule has been submitted and accepted by Owner.
- 2. Format:
 - a. Include submittals using early start dates.
 - b. Include all submittals, including those required in the Preliminary Schedule of Submittals.
 - c. Indicate week and month anticipated for each submittal.
 - d. Indicate "Priority" submittals where review time can impact Contractor's schedule:
 - 1) "Priority" indication will not alter review times specified in Section 01_33_00 - Submittal Procedures.
 - 2) Engineer will endeavor to provide early review of "Priority" submittals where possible.
- 3. Submittal of Final Schedule of Submittals shall be a condition precedent to Owner making progress payments after the first 90 calendar days after Notice to Proceed.

- D. Provide updated Schedule of Submittals with updated schedules if schedule revisions change listing and timing of submittals.

1.13 BASELINE SCHEDULE AND BASELINE SCHEDULE OF VALUES

- A. As specified in the General Terms and Conditions.

1.14 SUMMARY SCHEDULE

- A. Due date: At weekly progress meetings and after each Schedule Update or Schedule Revision.
- B. Format:
 - 1. Consolidate groups of activities associated with Major Items of Work shown on Baseline Schedule.
 - 2. intended to give an overall indication of the project schedule without a large amount of detail.

1.15 COST FLOW SUMMARY

- A. Due date: Submit on a monthly basis.
- B. Format:
 - 1. Tabular and graphic report showing anticipated earnings each month of the Contract period.

2. Base tabulation on the summation of the cost-loaded activities each month.
3. Show planned amounts.
4. Show actual earned amounts and anticipated remaining earnings.
5. Spreadsheet format of all schedule activities showing cost and percentage completion during the current month for which payment is sought.

1.16 PROGRESS SCHEDULE AND UPDATED SCHEDULE OF VALUES

- A. Due date: Submit on a monthly basis as specified in General Terms and Conditions.
- B. Format: Schedule of Values: As specified in General Terms and Conditions.

1.17 WEEKLY SCHEDULE

- A. Due date: At every weekly progress meeting.
- B. Format:
 1. Contractor and Engineer must agree on the format.
 2. 6-Week Schedule showing the activities completed during the previous week and the Contractor's schedule of activities for following 5 weeks.
 3. Use the logic and conform to the status of the current progress schedule when producing a Weekly Schedule in CPM schedule or a bar chart format:
 - a. In the event that the Weekly Schedule no longer conforms to the current schedule, Contractor may be required to revise the schedule as specified in this Section.
 4. The activity designations used in the Weekly Schedule must be consistent with those used in the Baseline Schedule and the monthly Schedule Updates.

1.18 MANPOWER SCHEDULE

- A. Due date: With progress payments after Baseline Schedule has been submitted and accepted by Owner.
- B. Format:
 1. Schedule histogram depicting total craft manpower and craft manpower for Contractor's own labor forces and those of each subcontractor.
 2. Submit electronically in Excel format, with 1 paper copy.
- C. Progress payments after the first 90 calendar days after Notice to Proceed will not be made until manpower schedule is provided.

1.19 FINAL SCHEDULE

- A. The final Schedule Update becomes the As-Built Schedule:
 1. The As-Built Schedule reflects the exact manner in which the project was constructed by reflecting actual start and completion dates for all activities accomplished on the project.
 2. Contractor's Project Manager and scheduler sign and certify the As-Built Schedule as being an accurate record of the way the project was actually constructed.
- B. Retainage will not be released until final Schedule Update is provided.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01_33_00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements and procedures for submittals.
- B. This Section is supplementary to City of Mercer Island General Terms and Conditions Article 4.5. If requirements are contradictory, more stringent requirements apply.

1.02 GENERAL INSTRUCTIONS

- A. Contractor is responsible to determine and verify field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and check and coordinate each item with other applicable approved shop drawings and Contract Document requirements.
- B. Provide submittals:
 - 1. That are specified or reasonably required for construction, operation, and maintenance of the Work.
 - 2. That demonstrate compliance with the Contract Documents.
- C. Where multiple submittals are required, provide a separate submittal for each specification section:
 - 1. In order to expedite construction, the Contractor may make more than 1 submittal per specification section, but a single submittal may not cover more than 1 specification section:
 - a. The only exception to this requirement is when 1 specification section covers the requirements for a component of equipment specified in another section.
 - b. For example, circuit breakers are a component of switchgear. The switchgear submittal must also contain data for the associated circuit breakers, even though they are covered in a different specification section.
- D. Prepare submittals in the English language. Do not include information in other languages.
- E. Present measurements in customary American units (feet, inches, pounds, etc.).
- F. Must be clear and legible, and of sufficient size for presentation of information.
- G. Page size other than drawings:
 - 1. Minimum page size will be 8 1/2 inches by 11 inches.
 - 2. Maximum page size will be 11 inches by 17 inches.

- H. Drawing sheet size:
 - 1. Maximum sheets size: 22-inch by 34-inch:
 - a. Minimum plan scale: 1/8-inch equals 1 foot-0 inches.
 - b. Minimum font size: 1/8 inch minimum.
 - 2. 11-inch by 17-inch sheet:
 - a. Minimum plan scale: 1/8-inch equals 1 foot-0 inches.
 - b. Minimum font size: 1/8 inch minimum.
- I. Show dimensions, construction details, wiring diagrams, controls, manufacturers, catalog numbers, and all other pertinent details.
- J. Provide submittal information from only 1 manufacturer for a specified product. Submittals with multiple manufacturers for 1 product will be rejected without review.

1.03 SUBMITTAL ORGANIZATION

- A. Organize submittals in exactly the same order as the items are referenced, listed, and/or organized in the specification section.
- B. For submittals that cover multiple devices used in different areas under the same specification section, the submittal for the individual devices must list the area where the device is used.
- C. Bookmarks:
 - 1. Bookmarks shall match the table of contents.
 - 2. Bookmark each section (tab) and heading.
 - 3. Drawings: Bookmark at a minimum, each discipline, area designation, or appropriate division.
 - 4. At file opening, display all levels of bookmarks as expanded.
- D. Where applicable (i.e. except for drawings, figures, etc.) submittal content shall be electronically searchable utilizing the PDF file as submitted.
- E. Thumbnails optimized for fast web viewing.
- F. Sequentially number pages within the tabbed sections:
 - 1. Submittals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review.
- G. Attachments:
 - 1. Specification section: Include with each submittal a copy of the relevant specification section:
 - a. Indicate in the left margin, next to each pertinent paragraph, either compliance with a check (✓) or deviation with a consecutive number (1, 2, 3).
 - b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
 - 2. Drawings: Include with each submittal a copy of the relevant Drawing, including relevant addendum updates:
 - a. Indicate either compliance with a check (✓) or deviation with a consecutive number (1, 2, 3).
 - b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.

- c. Provide field dimensions and relationship to adjacent or critical features of the Work or materials.

- H. Contractor: Prepare submittal information in sufficient detail to show compliance with specified requirements:
 - 1. Determine and verify quantities, field dimensions, product dimensions, specified design and performance criteria, materials, catalog numbers, and similar data.
 - 2. Coordinate submittal with other submittals and with the requirements of the Contract Documents.
 - 3. Check, verify, and revise submittals as necessary to bring them into conformance with Contract Documents and actual field conditions.

- I. Contractor: Prepare "Or Equal" submittal information:
 - 1. Provide standard submittal requirements:
 - a. In addition, provide in sufficient detail to show reason for variance from specified product and impacts.
 - 2. Provide reason the specified product is not being provided.
 - 3. Explain the benefits to the Owner for accepting the "Or Equal".
 - 4. Itemized comparison of the proposed "Or Equal" with product specified including a list of significant variations:
 - a. Design features.
 - b. Design dimensions.
 - c. Installation requirements.
 - d. Operations and maintenance requirements.
 - e. Availability of maintenance services and sources of replacement materials.
 - 5. Reference projects where the product has been successfully used:
 - a. Name and address of project.
 - b. Year of installation.
 - c. Year placed in operation.
 - d. Name of product installed.
 - e. Point of contact: Name and phone number.
 - 6. Define impacts:
 - a. Impacts to other contracts.
 - b. Impacts to other work or products.
 - 7. Contractor represents the following:
 - a. Contractor bears the burden of proof of the equivalency of the proposed "Or Equal".
 - b. Proposed "Or Equal" is equal or superior to the specified product.
 - c. Contractor will provide the warranties or bonds that would be provided on the specified product on the proposed "Or Equal", unless Owner requires a Special Warranty.
 - d. Contractor will coordinate installation of accepted "Or Equal" into the Work and will be responsible for the costs to make changes as required to the Work.
 - e. Contractor waives rights to claim additional costs caused by proposed "Or Equal" which may subsequently become apparent.

- J. Contractor: Prepare substitution submittal information:
1. Provide standard submittal requirements:
 - a. In addition, provide in sufficient detail to show reason for variance from specified product and impacts.
 2. Provide reason the specified product is not being provided.
 3. Explain the benefits to the Owner for accepting the substitution.
 4. Itemized comparison of the proposed substitution with product specified including a list of significant variations:
 - a. Design features.
 - b. Design dimensions.
 - c. Installation requirements.
 - d. Operations and maintenance requirements.
 - e. Availability of maintenance services and sources of replacement materials.
 5. Reference projects where the product has been successfully used:
 - a. Name and address of project.
 - b. Year of installation.
 - c. Year placed in operation.
 - d. Name of product installed.
 - e. Point of contact: Name and phone number.
 6. Define impacts:
 - a. Impacts to Contract Price:
 - 1) Required license fees or royalties.
 - 2) Do not include costs under separate contracts.
 - 3) Do not include Engineer's costs for redesign or revision of Contract Documents.
 - b. Impacts to Contract Time.
 - c. Impacts to Contract Scope.
 - d. Impacts to other contracts.
 - e. Impacts to other work or products.
 7. Contractor represents the following:
 - a. Contractor shall pay associated costs for Engineer to evaluate the substitution.
 - b. Contractor bears the burden of proof of the equivalency of the proposed substitution.
 - c. Proposed substitution does not change the design intent and will have equal performance to the specified product.
 - d. Proposed substitution is equal or superior to the specified product.
 - e. Contractor will provide the warranties or bonds that would be provided on the specified product on the proposed substitution, unless Owner requires a Special Warranty.
 - f. Contractor will coordinate installation of accepted substitution into the Work and will be responsible for the costs to make changes as required to the Work.
 - g. Contractor waives rights to claim additional costs caused by proposed substitution which may subsequently become apparent.

1.04 SUBMITTAL METHOD AND FORMAT

A. Submittal identification numbering:

1. Number each submittal using the format defined below:

	Spec Section Number	Dash	Initial Submittal - Sequential Number	Decimal Point	Subsequent Submittal Revisions Sequential Number
<i>Example 1 Description</i>	<i>Cast-In-Place Concrete</i>		<i>8th initial submittal</i>		
	03_30_01	-	0008		
<i>Example 2 Description</i>	<i>Cast-In-Place Concrete</i>		<i>8th initial submittal</i>		<i>First revision to the 8th initial submittal</i>
	03_30_01	-	0008	.	1

B. Submittals in electronic media format:

1. General: Provide all information in PC-compatible format using Windows® operating system as utilized by the Owner and Engineer.
2. Text: Provide text documents and manufacturer's literature in Portable Document Format (PDF).
3. Graphics: Provide graphic submittals (drawings, diagrams, figures, etc.) utilizing Portable Document Format (PDF).

1.05 SUBMITTAL PROCEDURE

A. Engineer: Review submittal and provide response:

1. Review description:
 - a. Engineer will be entitled to rely upon the accuracy or completeness of designs, calculations, or certifications made by licensed professionals accompanying a particular submittal whether or not a stamp or seal is required by Contract Documents or Laws and Regulations.
 - b. Engineer's review of submittals shall not release Contractor from Contractor's responsibility for performance of requirements of Contract Documents. Neither shall Engineer's review release Contractor from fulfilling purpose of installation nor from Contractor's liability to replace defective work.
 - c. Engineer's review of shop drawings, samples, or test procedures will be only for conformance with design concepts and for compliance with information given in Contract Documents.
 - d. Engineer's review does not extend to:
 - 1) Accuracy of dimensions, quantities, or performance of equipment and systems designed by Contractor.
 - 2) Contractor's means, methods, techniques, sequences, or procedures except when specified, indicated on the Drawings, or required by Contract Documents.

- 3) Safety precautions or programs related to safety which shall remain the sole responsibility of the Contractor.
 - e. Engineer can Approve or Not Approve any exception at their sole discretion.
2. Review timeframe:
 - a. Except as may be provided in technical specifications, a submittal will be returned within 30 days.
 - b. When a submittal cannot be returned within the specified period, Engineer will, within a reasonable time after receipt of the submittal, give notice of the date by which that submittal will be returned.
 - c. Engineer's acceptance of progress schedule containing submittal review times less than those specified or agreed to in writing by Engineer will not constitute Engineer's acceptance of review times.
 - d. Critical submittals:
 - 1) Contractor will notify Engineer in writing that timely review of a submittal is critical to the progress of Work.
3. Schedule delays:
 - a. No adjustment of Contract Times or Contract Price will be allowed due to Engineer's review of submittals, unless all of the following criteria are met:
 - 1) Engineer has failed to review and return first submission within the agreed upon time frame.
 - 2) Contractor demonstrates that delay in progress of Work is directly attributable to Engineer's failure to return submittal within time indicated and accepted by Engineer.
4. Review response will be returned to Contractor with one of the following dispositions:
 - a. Approved:
 - 1) No Exceptions:
 - a) There are no notations or comments on the submittal and the Contractor may release the equipment for production.
 - 2) Make Corrections Noted - See Comments:
 - a) The Contractor may proceed with the work, however, all notations and comments must be incorporated into the final product.
 - b) Resubmittal not required.
 - 3) Make Corrections Noted - Confirm:
 - a) The Contractor may proceed with the work, however, all notations and comments must be incorporated into the final product.
 - b) Submit confirmation specifically addressing each notation or comment to the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the confirmation.
 - b. Not approved:
 - 1) Correct and resubmit:
 - a) Contractor may not proceed with the work described in the submittal.
 - b) Contractor assumes responsibility for proceeding without approval.
 - c) Resubmittal of complete submittal package is required within 30 calendar days of the date of the Engineer's submittal review response.

- 2) Rejected - See Remarks:
 - a) Contractor may not proceed with the work described in the submittal.
 - b) The submittal does not meet the intent of the Contract Documents. Resubmittal of complete submittal package is required with materials, equipment, methods, etc. that meet the requirements of the Contract Documents.
 - c. Receipt acknowledged - Filed for record:
 - 1) This is used in acknowledging receipt of informational submittals that address means and methods of construction such as schedules and work plans, conformance test reports, health and safety plans, etc.
 - d. Receipt acknowledged with comments - Resubmit:
 - 1) This is used in acknowledging receipt of informational submittals that address means and methods of construction such as schedules and work plans, conformance test reports, health and safety plans, etc. Feedback regarding missing information, conflicting information, or other information that makes it incomplete can be made with comments.
- B. Contractor: Prepare resubmittal, if applicable:
1. Clearly identify each correction or change made.
 2. Include a response in writing to each of the Engineer's comments or questions for submittal packages that are resubmitted in the order that the comments or questions were presented throughout the submittal and numbered consistent with the Engineer's numbering:
 - a. Acceptable responses to Engineer's comments are listed below:
 - 1) "Incorporated" Engineer's comment or change is accepted and appropriate changes are made.
 - 2) "Response" Engineer's comment not incorporated. Explain why comment is not accepted or requested change is not made. Explain how requirement will be satisfied in lieu of comment or change requested by Engineer.
 - b. Reviews and resubmittals:
 - 1) Contractor shall provide resubmittals which include responses to all submittal review comments separately and at a level of detail commensurate with each comment.
 - 2) Contractor responses shall indicate how the Contractor resolved the issue pertaining to each review comment. Responses such as "acknowledged" or "noted" are not acceptable.
 - 3) Resubmittals which do not comply with this requirement may be rejected and returned without review.
 - 4) Contractor shall be allowed no extensions of any kind to any part of their contract due to the rejection of non-compliant submittals.
 - 5) Submittal review comments not addressed by the Contractor in resubmittals shall continue to apply whether restated or not in subsequent reviews until adequately addressed by the Contractor to the satisfaction of the reviewing and approving authority.
 - c. Any resubmittal that does not contain responses to the Engineer's previous comments shall be returned for Revision and Resubmittal. No further review by the Engineer will be performed until a response for previous comments has been received.

3. Resubmittal timeframe:
 - a. Contractor shall provide resubmittal within 15 days.
 - b. When a resubmittal cannot be returned within the specified period, Contractor shall notify Engineer in writing.
4. Review costs:
 - a. Costs incurred by Owner as a result of additional reviews of a particular submittal after the second time it has been reviewed shall be borne by Contractor.
 - b. Reimbursement to Owner will be made by deducting such costs from Contractor's subsequent progress payments.

1.06 PRODUCT DATA

- A. Edit submittals so that the submittal specifically applies to only the product furnished.
- B. Neatly cross out all extraneous text, options, models, etc. that do not apply to the product being furnished, so that the information remaining is only applicable to the product being furnished.

1.07 SHOP DRAWINGS

- A. Contractor to field verify elevation, coordinates, and pipe material for pipe tie-in to pipeline or structure prior to the preparation of shop drawings.
- B. Indicate project designated equipment tag numbers for submittal of devices, equipment, and assemblies.

1.08 SAMPLES

- A. Details:
 1. Submit labeled samples.
 2. Samples will not be returned.
 3. Provide number of sample submittals as below:
 - a. Total: 2 minimum:
 - 1) Owner: 1.
 - 2) Engineer: 1.
 - 3) Contractor: None.

PART 1 PRODUCTS

Not Used.

PART 2 EXECUTION

Not Used.

APPENDIX B
CONTRACTOR SUBMITTAL TRANSMITTAL FORM

**DOCUMENT 01_33_00
CONTRACTOR SUBMITTAL TRANSMITTAL FORM**

Owner: Click here to enter text. **Date:** MM/DD/YYYY
Contractor: Click here to enter text. **Project No.:** XXXXX.XX
Project Name: Click here to enter text. **Submittal Number:** 000
Submittal Title: Click here to enter text.
To: Click here to enter text.
From: Click here to enter text. Click here to enter text.
Click here to enter text. Click here to enter text.

Specification No. and Subject of Submittal / Equipment Supplier			
Spec ##:	Spec ##.	Subject:	Click here to enter text.
Authored By:	Click here to enter text.	Date Submitted:	XX/XX/XXXX

Submittal Certification
Check Either (A) or (B):
<input type="checkbox"/> (A) We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings with no exceptions.
<input type="checkbox"/> (B) We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings except for the deviations listed.
Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements.
General Contractor's Reviewer's Signature:
Printed Name:
In the event, Contractor believes the Submittal response does or will cause a change to the requirements of the Contract, Contractor shall immediately give written notice stating that Contractor considers the response to be a Change Order.
Firm: Click here to enter text. Signature: _____ Date Returned: XX/XX/XXXX

PM/CM Office Use
Date Received GC to PM/CM: _____
Date Received PM/CM to Reviewer: _____
Date Received Reviewer to PM/CM: _____
Date Sent PM/CM to GC: _____

END OF SECTION

SECTION 01_35_03

SPECIAL PROCEDURES FOR LOCATING AND VERIFYING CONCEALED EXISTING UTILITIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Special procedures for locating and verifying concealed existing utilities.

1.02 CONCEALED EXISTING UTILITIES

- A. Underground utilities are shown in their approximate location. There is no guarantee that all utility lines are shown, or that the depth, location, size and material is accurate. Existing water service lines shall be assumed to be un-locatable because they generally lack tracer wire. City staff will mark the service only to alert the Contractor of its presence. The Contractor shall exercise extreme caution when locating services. Services broken or damaged shall be repaired immediately. The Contractor shall uncover all indicated piping where crossing, interferences, or connections occur prior to trenching or excavation for any pipe or structures, to determine actual depth, locations, size and material. The Contractor shall make the appropriate provision for protection of said facilities. The Contractor shall notify One Call at 8-1-1 two business days in advance and arrange for field location of existing facilities before construction. See Section 01_14_00 - Work Restrictions for additional requirements:
 - 1. Abide by easement and right-of-way restrictions.
 - 2. Potholing shall be backfilled immediately after purpose has been satisfied and the surface restored and maintained in a manner satisfactory to Engineer.
 - 3. Adjustments in construction methods shall be made to accommodate utility location information gained from potholing as necessary to protect existing utilities and maintain plant in operations.
 - 4. Note that installation of all underground yard piping and utilities in this project are considered to be installed in congested utility areas.
 - 5. Some variation from the conditions indicated on the Drawings is to be expected.
- B. Notify the Owner, owners of facilities when the Work will be in progress.
- C. Make arrangements for potential emergency repairs in accordance with requirements of owners of utility facilities, including individual or residential facilities.
- D. Assume responsibility for repair of utilities and facilities damaged by performance of the Work.

- E. Work required for raising, lowering, or relocating utilities not indicated will be performed by affected utility owners or as part of the Work at option of affected owners of utilities:
 - 1. When part of the Work, perform work in accordance with standards of affected utility owner, and adjustment to Contract Price and Contract Times will be made as stipulated in conditions of Contract.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01_35_21

SELECTIVE ALTERATIONS AND DEMOLITION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Cutting or modifying of existing and new work.
 - 2. Partial demolition of structures.
 - 3. In-place abandonment of pipe.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. A10.6 - Safety and Health Program Requirements for Demolition Operations.
- B. International Concrete Repair Institute (ICRI):
 - 1. Guideline No. 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
 - 2. Guideline No. 310.3R - Guide for the Preparation of Concrete Surfaces for Repair Using Hydrodemolition Methods.

1.03 DEFINITIONS

- A. Chipping hammer: A hand-operated electrical or pneumatic demolition device for removal of hardened concrete or masonry materials having a weight of less than 15 pounds and an impact frequency of greater than 2,000 blows/minute.
- B. Concrete breaker: A hand-operated electrical or pneumatic demolition device for removal of hardened concrete or masonry materials having a weight greater or impact frequency less than the limits defined for a chipping hammer.
- C. Coring equipment: Non-impact rotary drill with diamond cutting edges.
- D. Heavy abrasive blast: Cleaning procedure by which various abrasives materials, or steel shot, are forcibly propelled by high pressure against a surface to remove loose material and produce a concrete surface roughened to ICRI Surface Profile CSP-7, or higher, as specified in ICRI 301.3R.

1.04 DESCRIPTION OF WORK

- A. The work includes partial demolition, cutting, and modifying of existing facilities, utilities, and/or structures.
- B. These facilities may be occupied and/or operational. Satisfactory completion of the work will require that the Contractor plan activities carefully to work around unavoidable obstacles and to maintain overall stability of structures and structural elements. It will further require restoration of existing facilities, utilities, and

structures that are to remain in place and that are damaged by demolition or removal operations.

1.05 SUBMITTALS

- A. General:
 - 1. Submit specified in Section 01_33_00 - Submittal Procedures.
- B. Shop drawings: Include:
 - 1. The location of all embedded items shall be documented using diagrams and/or other media that clearly show dimensions and locations of existing structural elements, existing embedded items and any new embedded items and their relationship to each other.
- C. Submittals for information only:
 - 1. Permits and notices authorizing demolition.
 - 2. Certificates of severance of utility services.
 - 3. Permit for transport and disposal of debris.
 - 4. Selective Demolition Plan.
- D. Quality assurance submittals:
 - 1. Qualifications of non-destructive testing agency/agencies.
- E. Project record documents.
- F. Drawings and/or other media documenting locations of service lines and capped utilities.

1.06 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Assign relocation, removal, cutting, coring and patching to trades and workers qualified to perform the Work in manner that causes the least damage and that provides means of returning surfaces to an appearance at least equal to that of the surrounding areas unaffected by the Work.
 - 2. Non-destructive testing agencies: Minimum of 5 years' experience performing non-destructive testing for location of steel reinforcement in existing concrete under conditions similar to that required for this Work.

1.07 SEQUENCING

- A. Perform Work in sequences and within times specified in Section 01_14_00 - Work Restrictions.
- B. If the facility or utility to be modified cannot be removed from service, perform the Work while the facility is in operation using procedures and equipment that do not jeopardize operation or materially reduce the efficiency of that facility.
- C. Coordinate the Work with operation of the facility:
 - 1. Do not begin alterations of designated portions of the Work until specific permission for activities in each area has been granted by Owner in writing.
 - 2. Complete Work as quickly and with as little delay as possible.

- D. Operational functions of the facility that are required to be performed to facilitate the Work will be performed by facility personnel only.
- E. Owner will cooperate in every way practicable to assist in expediting the Work.
- F. When necessary for the proper operation or maintenance of portions of the facility, reschedule operations so the Work will not conflict with required operations or maintenance.

1.08 REGULATORY REQUIREMENTS

- A. Dispose of debris in accordance with governing regulatory agencies.
- B. Comply with applicable air pollution control regulations.
- C. Obtain permits for building demolition, transportation of debris to disposal site and dust control.

1.09 PREPARATION

- A. Non-destructive evaluation of existing concrete:
 - 1. Prior to cutting, drilling, coring, and/or any other procedure that penetrates existing concrete, retain and pay for the services of a qualified non-destructive testing agency to perform investigations to determine the location of existing steel reinforcement, plumbing, conduit, and/or other embedments in the concrete.
 - 2. Submit documentation of the investigations to the Engineer for review and approval as specified in Section 01_33_00 - Submittal Procedures before any work involving penetration of existing concrete is initiated.

1.10 PROJECT CONDITIONS

- A. Do not interfere with use of adjacent structures and elements of the facility not subject to the Work described in this Section. Maintain free and safe passage to and from such facilities.
- B. Provide, erect, and maintain barricades, lighting, guardrails, and protective devices as required to protect building occupants, general public, workers, and adjoining property:
 - 1. Do not close or obstruct roadways without permits.
 - 2. Conduct operations with minimum interference to public or private roadways.
- C. Prevent movement, settlement, or collapse of structures adjacent services, sidewalks, driveways and trees:
 - 1. Provide and place bracing or shoring.
 - 2. Cease operations and notify Engineer immediately when safety of structures appears to be endangered. Take precautions to properly support structure. Do not resume operations until safety is restored.
 - 3. Assume liability for movement, settlement, or collapse. Promptly repair damage.

- D. Arrange and pay for capping and plugging utility services. Disconnect and stub off:
 - 1. Notify affected utility company in advance and obtain approval before starting demolition.
 - 2. Place markers to indicate location of disconnected services.
- E. Unknown conditions:
 - 1. The drawings may not represent all conditions at the site and adjoining areas. Compare actual conditions with drawings before commencement of Work.
 - 2. Existing utilities and drainage systems below grade are located from existing documents and from surface facilities such as manholes, valve boxes, area drains, and other surface fixtures.
 - 3. If existing active services encountered are not indicated or otherwise made known to the Contractor and interfere with the permanent facilities under construction, notify the Engineer in writing, requesting instructions on their disposition. Take immediate steps to ensure that the service provided is not interrupted, and do not proceed with the Work until written instructions are received from the Engineer.

PART 2 PRODUCTS

2.01 SALVAGE MATERIALS

- A. Salvage materials: Materials removed from existing facility.
- B. Materials designated for salvage:
 - 1. Coordinate in the field with Owner Representative for salvage of valves or equipment.
- C. Handling and storage:
 - 1. Prevent damage to salvaged materials during removal, handling, and transportation of salvaged materials.
 - 2. Prepare salvaged materials for storage:
 - a. Owner shall provide storage materials as needed.
 - 3. Store salvaged materials in the following locations:
 - a. Owner shall transport and store salvaged materials as needed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Prior to beginning selective demolition operations, perform a thorough inspection of the facility and site, and report to the Engineer defects and structural damage to or deterioration of existing construction to remain.
- B. Examine areas affected by the Work and verify the following conditions prior to commencing demolition:
 - 1. Disconnection of utilities as required.
 - 2. That utilities serving occupied or active portions of surrounding facilities will not be disturbed, except as otherwise indicated.

- C. If unsatisfactory conditions exist, notify the Engineer, and do not begin demolition operations until such conditions have been corrected.

3.02 PREPARATION

- A. Selective Demolition Plan:
 - 1. Prepare and submit a comprehensive selective demolition plan for the Work including, at a minimum:
 - a. Proposed sequence.
 - b. Methods.
 - c. Temporary support.
 - d. Equipment for demolition, removal, and disposal of portions of structure(s).
 - 2. Submit plan a minimum 4 weeks before demolition is scheduled to begin.
- B. Protection:
 - 1. Erect weatherproof closures to protect the interior of facilities and elements or equipment that are not designed for exposure to the weather. Provide temporary heat, cooling, and humidity control as necessary to prevent damage to existing and new construction. Maintain existing exiting paths and/or provide new paths in compliance with Building Code requirements.
 - 2. Erect and maintain dustproof partitions as required to prevent spread of dust, to other parts of building. Maintain negative pressure in the area where the Work is being performed to prevent the accidental spread of dust and to minimize the spread of fumes related to the Work.
 - 3. Upon completion of Work, remove weatherproof closures and dustproof partitions, and repair damaged surfaces to match adjacent surfaces.
 - 4. Provide and maintain protective devices to prevent injury from falling objects.
 - 5. Locate guardrails in stairwells and around open shafts to protect workers. Post clearly visible warning signs.
 - 6. Cause as little inconvenience to adjacent building areas as possible.
 - 7. Protect landscaping, benchmarks, and existing construction to remain from damage or displacement.
 - 8. Carefully remove designated materials and equipment to be salvaged by Owner or reinstalled.
 - 9. Store and protect materials and equipment to be reinstalled.
- C. Layout:
 - 1. Demolition requirements are indicated on drawings. Confine demolition operations to the locations indicated.
 - 2. Lay out demolition and removal work at the site and coordinate with related Work for which demolition and removal is required. Clearly mark the extent of structural elements to be removed on the actual surfaces that will be removed.
 - 3. Arrange for Engineer's inspection of the lay out extents.
 - 4. Do not begin demolition/removal operations until the lay out markings have been reviewed by the Engineer.

3.03 DEMOLITION

- A. General:
 - 1. Perform demolition work in accordance with ANSI A10.6.

2. Demolish designated portions of structures and appurtenances in orderly and careful manner in accordance with the Selective Demolition Plan.
 3. Conduct demolition and removal work in a manner that will minimize dust and flying particles:
 - a. Use water or dust palliative when necessary to prevent airborne dust.
 - b. Provide and maintain hoses and connections to water main or hydrant.
 4. Demolish concrete and masonry in small sections. Perform demolition with small tools as much as possible. Blasting with explosive charges is not permitted.
 5. Sawcut concrete to establish the edges of demolition, wherever possible:
 - a. Do not use a concrete breaker within 6 inches of reinforcing or structural metals that are designated to remain.
 - b. At edges that are not sawcut, remove the final 6 inches of material with a chipping hammer as defined herein. At surfaces where material is removed with a chipping hammer, follow with a heavy abrasive blast to remove all loose material and microcracking.
 - c. Alternate techniques to remove concrete may be used if acceptable to the Engineer; however, techniques other than those deemed by ICRI Guideline No. 310.2R to provide a low risk of introducing microcracking will require a subsequent procedure to remove loose material.
 - d. Provide final surface preparation for repairs as specified in Section 03_01_04 - Structural Concrete Repair.
 6. Remove materials carefully, to the extent indicated and as required:
 - a. Provide neat and orderly junctions between existing and new materials.
 - b. Use methods that terminate surfaces in straight lines at natural points of division.
 7. Do not remove anything beyond the limits of Work indicated without prior written authorization of the Engineer. If in doubt about whether to remove an item, obtain written authorization of the Engineer prior to proceeding.
 8. Perform work so as to provide the least interference and most protection to existing facilities to remain.
 9. Assume possession of demolished materials, unless otherwise indicated or specified:
 - a. Remove demolished materials from site at least weekly and dispose of in accordance with Laws and Regulations.
 - b. Do not burn materials on site.
- B. Sizing of openings in existing concrete or masonry:
1. Make openings large enough to permit final alignment of pipe and fittings without deflections, but without oversizing.
 2. Allow adequate space for packing around pipes and conduit to ensure watertightness.
 3. If the Engineer deems the opening to be insufficient in size to accomplish this criteria, remove additional material using the procedures outlined in this Section.
- C. Cutting openings in existing concrete or masonry:
1. Do not allow saw cuts to extend beyond limits of openings.
 2. Create openings by the following method or other means acceptable to the Engineer that prevents over-cutting of member at corners:
 - a. Core-drill through slab or wall at corners, being careful not to damage materials beyond the area to be removed.

- b. Saw cut completely through the member, between the core holes at the corners.
 - c. As an alternate to sawcutting through the member, score the edges of the opening with a saw to a 1-inch depth on both surfaces (when accessible):
 - 1) Remove concrete or masonry to within 6 inches of material to remain with a concrete breaker.
 - 2) Remove the remaining material with a chipping hammer.
 - d. Remove the remaining material at the corners left by the core-drilling with a chipping hammer.
- 2. Prevent debris from damaging existing equipment and other facilities.
- D. Immediately upon discovery, remove and dispose of contaminated, vermin-infested, or dangerous materials using safe means that will not endanger health of workers and public.
 - E. Remove trees and shrubs within marked areas; clear undergrowth and dead plant material as specified in Section 31_00_00 - Earthwork.
 - F. Backfill open pits and holes caused by demolition as specified in Section 31_00_00 - Earthwork.
 - G. Rough grade areas affected by demolition.
 - H. Remove demolished materials, tools, and equipment upon completion of demolition.

3.04 RESTORATION

- A. General:
 - 1. Repair damage caused by demolition to conditions equal to those that existing prior to beginning of demolition:
 - a. Patch and replace portions of existing finished surfaces that are damaged, lifted, and discolored with matching material. Refinish patched portion surfaces in a manner which produces uniform color and texture to entire surface.
 - b. When existing finish cannot be matched, refinish entire surface to nearest change of plane where angle of change exceeds 45 degrees.
 - 2. The cost of repairs shall be at the Contractor's expense at no increase in the Contract Price.
 - 3. When new construction abuts or finishes flush with existing construction, make smooth transitions. Match finish of existing construction.
 - 4. Where partitions are removed, patch floors, walls, and ceilings with finish materials that match existing materials.
 - 5. Where removal of partitions results in adjacent spaces becoming one, rework floors, walls, and ceilings to provide smooth planes without breaks, steps, or bulkheads.
 - 6. Where changes of plane exceed 2 inches, request instructions for making transition.
 - 7. Trim and refinish existing doors as necessary to clear new floors.
 - 8. Match patched construction with adjacent construction in texture and appearance so that patch or transition is invisible at 5-foot distance.
 - 9. When finished surfaces are cut so that smooth transition is impossible, terminate existing surface in neat manner along straight line at natural line of division and provide appropriate trim.

- B. Restore existing concrete reinforcement as follows:
 - 1. Where existing reinforcement is to be incorporated into the new Work, protect, clean, and extend into new concrete.
 - 2. Where existing reinforcement is not to be retained, cut off as follows:
 - a. Where new concrete joins existing concrete at the removal line, cut reinforcement flush with concrete surface at the removal line.
 - b. Where concrete surface at the removal line will become the finished surface, cut reinforcement 2 inches below the surface, paint ends with epoxy, and patch holes with dry pack mortar.

- C. Restore areas affected by removal of existing equipment, equipment pads and bases, piping, supports, electrical panels, electric devices, and conduits such that little or no evidence of the previous installation remains:
 - 1. Fill areas in existing floors, walls, and ceilings from removed piping, conduit, and fasteners with non-shrink grout and finish smooth.
 - 2. Remove concrete bases for equipment and supports by:
 - a. Saw cutting clean, straight lines with a depth equal to the concrete cover over reinforcement minus 1/2 inch below finished surface:
 - 1) Do not cut existing reinforcement on floors.
 - b. Chip concrete within scored lines and cut exposed reinforcing steel and anchor bolts.
 - c. Patch with non-shrink grout to match adjacent grade and finish.
 - 3. Terminate abandoned piping and conduits with blind flanges, caps, or plugs.

3.05 FIELD QUALITY CONTROL

- A. Do not proceed with demolition without Engineer's inspection of lay out.

- B. Do not deviate from the submitted demolition plan without notifying the Engineer prior to Work.

END OF SECTION

SECTION 01_41_00

REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Regulatory authorities and codes.

1.02 AUTHORITIES HAVING JURISDICTION

- A. Building Department: City of Mercer Island Community Planning and Development.
- B. Fire Department: City of Mercer Island Fire Department.

1.03 APPLICABLE CODES

- A. Products in contact with drinking water:
 - 1. Materials in contact with drinking waters: In accordance with NSF 61 and NSF 372:
 - a. Certification by an independent ANSI accredited third party, including, but not limited to, NSF International, as being lead free.
- B. Washington State Building Codes Council (SBCC), Washington Administrative Code (WAC), Title 51 – Department of Commerce, Building Code Council:
 - 1. Building code:
 - a. International Building Code (IBC), 2018.
 - b. Washington State Amendments to the 2018 IBC (Chapter 51-50 WAC).
 - 2. Electrical code:
 - a. National Fire Protection Association (NFPA), NFPA 70: National Electrical Code (NEC), 2018.
 - 3. Energy code:
 - a. International Energy Conservation Code (IECC), 2018.
 - b. Washington State Amendments to the 2018 IECC (Chapter 51-11C WAC).
 - c. Washington State Energy Code, Commercial Provisions.
 - 4. Fire code:
 - a. International Fire Code (IFC), 2018.
 - b. Washington State Amendments to the 2018 IMC (Chapter 51-54A WAC).
 - 5. Mechanical code:
 - a. International Mechanical Code (IMC), 2018.
 - b. Washington State Amendments to the 2018 IMC (Chapter 51-52 WAC).
 - 6. Plumbing codes:
 - a. Uniform Plumbing Code (UPC), 2018.
 - b. Washington State Amendments to the 2018 UPC (Chapter 51-56 WAC).

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01_45_00

QUALITY CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Quality control and control of installation.
 - 2. Tolerances.
 - 3. References.
 - 4. Mock-up requirements.
 - 5. Authority and duties of Owner's representative or inspector.
 - 6. Sampling and testing.
 - 7. Testing and inspection services.
 - 8. Contractor's responsibilities.

1.02 QUALITY CONTROL AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. When manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce required and specified quality.
- F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
- H. When specified, products will be tested and inspected either at point of origin or at Work site:
 - 1. Notify Engineer in writing well in advance of when products will be ready for testing and inspection at point of origin.
 - 2. Do not construe that satisfactory tests and inspections at point of origin is final acceptance of products. Satisfactory tests or inspections at point of origin do not preclude retesting or re-inspection at Work site.
- I. Do not ship products which require testing and inspection at point of origin prior to testing and inspection.

1.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. When Manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.04 REFERENCES

- A. ASTM International (ASTM):
 - 1. E329 - Standard for Agencies Engaged in Construction Inspection, Testing or Special Inspection.
- B. National Institute of Standards and Technology (NIST).

1.05 PRODUCT REQUIREMENTS

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. When specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

1.06 MOCK-UP REQUIREMENTS

- A. Tests will be performed under provisions identified in this Section and identified in respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups shall be comparison standard for remaining Work.
- D. Where mock-up has been accepted by Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Engineer.

1.07 AUTHORITY AND DUTIES OF OWNER'S REPRESENTATIVE OR INSPECTOR

- A. Owner's Project Representative employed or retained by Owner is authorized to inspect the Work.

- B. Inspections may extend to entire or part of the Work and to preparation, fabrication, and manufacture of products for the Work.
- C. Deficiencies or defects in the Work which have been observed will be called to Contractor's attention.
- D. Inspector will not:
 - 1. Alter or waive provisions of Contract Documents.
 - 2. Inspect Contractor's means, methods, techniques, sequences, or procedures for construction.
 - 3. Accept portions of the Work, issue instructions contrary to intent of Contract Documents, or act as foreman for Contractor. Supervise, control, or direct Contractor's safety precautions or programs; or inspect for safety conditions on Work site, or of persons thereon, whether Contractor's employees or others.
- E. Inspector will:
 - 1. Conduct on-site observations of the Work in progress to assist Engineer in determining when the Work is, in general, proceeding in accordance with Contract Documents.
 - 2. Report to Engineer whenever Inspector believes that Work is faulty, defective, does not conform to Contract Documents, or has been damaged; or whenever there is defective material or equipment; or whenever Inspector believes the Work should be uncovered for observation or requires special procedures.

1.08 SAMPLING AND TESTING

- A. General:
 - 1. Prior to delivery and incorporation in the Work, submit listing of sources of materials, when specified in sections where materials are specified.
 - 2. When specified in sections where products are specified:
 - a. Submit sufficient quantities of representative samples of character and quality required of materials to be used in the Work for testing or examination.
 - b. Test materials in accordance with standards of national technical organizations.
- B. Sampling:
 - 1. Furnish specimens of materials when requested.
 - 2. Do not use materials which are required to be tested until testing indicates satisfactory compliance with specified requirements.
 - 3. Specimens of materials will be taken for testing whenever necessary to determine quality of material.
 - 4. Assist Engineer in preparation of test specimens at site of work, such as soil samples and concrete test cylinders.

1.09 TESTING AND INSPECTION SERVICES

- A. Contractor will employ and pay for specified services of an independent firm to perform Contractor quality control testing as required in the technical specifications for various work and materials.

- B. Owner will employ and pay for specified services of an “Owner’s independent testing firm” certified to perform testing and inspection as required in the technical specifications for various work and materials or stipulated in Section 01_45_24 - Regulatory Quality Assurance to confirm Contractor’s compliance with Contract Documents.
- C. The Owner’s independent testing firm will perform tests, inspections and other services specified in individual specification sections and as required by Owner and requested by the Engineer.
- D. The qualifications of laboratory that will perform the testing, contracted by the Owner or by the Contractor, shall be as follows:
 - 1. Has authorization to operate in the state where the project is located.
 - 2. Meets “Recommended Requirements for Independent Laboratory Qualification,” published by American Council of Independent Laboratories.
 - 3. Meets requirements of ASTM E329.
 - 4. Laboratory Staff: Maintain full time specialist on staff to review services.
 - 5. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to NIST or accepted values of natural physical constants.
 - 6. Will submit copy of report of inspection of facilities made by Materials Reference Laboratory of NIST during most recent tour of inspection, with memorandum of remedies of deficiencies reported by inspection.
- E. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing inspections and source quality control as required by Engineer or Owner.
- F. Contractor shall cooperate with Owner’s independent testing firm, furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested:
 - 1. Notify Engineer and Owner’s independent testing firm 48 hours prior to expected time for operations requiring testing.
 - 2. Make arrangements with Owner’s independent testing firm and pay for additional samples and tests required for Contractor’s use.
- G. Limitations of authority of testing Laboratory: Owner’s independent testing firm or Laboratory is not authorized to:
 - 1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Agency or laboratory may not approve or accept any portion of the Work.
 - 3. Agency or laboratory may not assume duties of Contractor.
 - 4. Agency or laboratory has no authority to stop the Work.
- H. Testing and employment of an Owner’s independent testing firm or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- I. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same Owner’s independent testing firm on instructions by Engineer. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

- J. The Owner's independent testing firm responsibilities will include:
 - 1. Test samples of mixes submitted by Contractor.
 - 2. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
 - 3. Perform specified sampling and testing of products in accordance with specified standards.
 - 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 5. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or products.
 - 6. Perform additional tests required by Engineer.
 - 7. Attend preconstruction meetings and progress meetings.

- K. Owner's independent testing firm individual test reports: After each test, Owner's independent testing firm will promptly submit electronically and 3 hard copies of report to Engineer and to Contractor. Include the following:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Name of inspector.
 - 4. Date and time of sampling or inspection.
 - 5. Identification of product and specifications section.
 - 6. Location in Project.
 - 7. Type of inspection or test.
 - 8. Date of test.
 - 9. Certified test results stamped and signed by a registered Engineer in the State of where the project is located.
 - 10. Summary of conformance with Contract Documents.
 - 11. When requested by Engineer, the Owner's independent testing firm will provide interpretation of test results.

- L. Owner's independent testing firm will provide monthly report of certification to identify all work performed for special inspections and other contract requirements on this project. The following certified monthly report at a minimum will include but not limited to:
 - 1. Results of testing.
 - 2. Testing logs.
 - 3. Outstanding deficiencies.
 - 4. Various statistical data.
 - 5. Testing curves (up to 4 types) as required by the Engineer.

1.10 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with Owner's independent testing firm or laboratory personnel and provide access to construction and manufacturing operations.

- B. Secure and deliver to Owner's independent testing firm or laboratory adequate quantities of representative samples of materials proposed to be used and which require testing.

- C. Provide to Owner's independent testing firm or laboratory and Engineer preliminary mix design proposed to be used for concrete, and other materials mixes which require control by testing laboratory.

- D. Furnish electronically and 5 hard copies of product test reports.
- E. Furnish incidental labor and facilities:
 - 1. To provide access to construction to be tested.
 - 2. To obtain and handle samples at Work site or at source of product to be tested.
 - 3. To facilitate inspections and tests.
 - 4. For storage and curing of test samples.
- F. Notify Owner's independent testing firm or laboratory 48 hours in advance of when observations, inspections and testing is needed for laboratory to schedule and perform in accordance with their notice of response time.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01_45_17

CONTRACTOR QUALITY CONTROL PLAN

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Contractor Quality Control Plan.

1.02 SUBMITTALS

- A. Qualifications of the Contractor's Quality Control (CQC) Plan Manager.
- B. Contractor's Daily Quality Control Report: Submit to Engineer within 1 day of completion of each inspection.
- C. Daily Inspection Report: Submit to Engineer at the end of each working day or no later than prior to the beginning of the next working day.

1.03 CONTRACTOR'S INSPECTION OF THE WORK

- A. Work performed by Contractor shall be inspected by the Contractor's CQC Plan Manager. Non-conforming Work and any safety hazards in the Work area shall be noted and promptly corrected.
- B. No materials or equipment shall be used in Work without inspection and acceptance by Contractor's CQC Plan Manager.

1.04 QUALIFICATIONS

- A. Contractor's CQC Plan Manager: Demonstrate having performed similar CQC functions on similar type projects. Submit records of personnel experience, training, and qualifying registrations.
- B. Minimum qualifications: Candidate must have a minimum of 10 years of experience on projects of similar type and size.

1.05 COVERING WORK

- A. Whenever Contractor intends to backfill, bury, cast in concrete, or otherwise cover any Work, notify Engineer not less than 24 hours in advance to request inspection before beginning any such Work of covering. Failure of Contractor to notify Engineer in accordance with this requirement shall be resolved according to Article 14 of the General Conditions.

1.06 CONTRACTOR'S QUALITY CONTROL PROGRAM

- A. General: Establish and execute a Quality Control (CQC) Plan for Work. The plan shall establish adequate measures for verification and conformance to defined

requirements by Contractor personnel and lower-tier Subcontractors (including Fabricators, Suppliers, and Subcontractors). This program shall be described in a Plan responsive to this Section.

B. CQC personnel:

1. Contractor's CQC Plan Manager shall report to a Senior Project Manager of the Contractor and shall have no supervisory or managerial responsibility over the workforce.
2. The Contractor CQC Plan Manager shall be on-site as often as necessary, but not less than the daily working hours specified in the Contract Documents to remedy and demonstrate that Work is being performed properly and to make multiple observations of Work in progress.
3. The Contractor is to furnish personnel with assigned CQC functions reporting to the CQC Manager. Persons performing CQC functions shall have sufficient qualifications, authority, and organizational freedom to identify quality problems and to initiate and recommend solutions.

C. CQC Plan:

1. Contractor's CQC Plan shall include a statement by the Senior Project Manager designating the CQC Plan Manager and specifying the authority delegated to the CQC Plan Manager to direct cessation or removal and replacement of defective Work.
2. Describe the CQC program and include procedures, work instructions, and records. Describe methods relating to areas that require special testing and procedures as required by the specifications.
3. Include specific instructions defining procedures for observing Work in process and comparing this Work with the Contract requirements (organized by specifications section).
4. Describe procedures to ensure that equipment or materials that have been accepted at the Site are properly stored, identified, installed and tested.
5. Include procedures to verify that procured products and services conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to lower-tier Suppliers and/or Subcontractors.
6. Commissioning quality control: Include procedures to verify that the commissioning requirements of the Contract Documents are integrated into the Contractor's CQC Plan and conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to the Contractor and the lower-tier Suppliers and/or Subcontractors.
7. Include instructions for recording inspections and requirements for demonstrating through the Daily Inspection Reports that Work inspected was in compliance or a deficiency was noted and action to be taken.
8. Procedures to preclude the covering of deficient or rejected Work.
9. Procedures for halting or rejecting Work.
10. Procedures for resolution of differences between the CQC Plan Manager and the production personnel.
11. Identify contractual hold/inspection points as well as any Contractor-imposed hold/inspection points.

D. Daily Inspection Report: Include, at a minimum:

1. Inspection of specific work.
2. Quality characteristics in compliance.

3. Quality characteristics not in compliance.
 4. Corrective/remedial actions taken.
 5. Statement of certification.
 6. CQC Manager's signature.
 7. Information provided on the daily report shall not constitute notice of delay or any other notice required by the Contract Documents.
- E. Deficient and Non-conforming Work and Corrective Action: Include procedures for handling deficiencies and non-conforming Work. Deficiencies and non-conforming Work are defined as documentation, drawings, material, equipment, or Work not conforming to the indicated requirements or procedures. The procedure shall prevent non-conformances by identification, documentation, evaluation, separation, disposition, and corrective action to prevent reoccurrence. Conditions having adverse effects on quality shall be promptly identified and reported to the senior level management. The cause of conditions adverse to quality shall be determined and documents and measures implemented to prevent recurrence. In addition, at a minimum, this procedure shall address:
1. Personnel responsible for identifying deficient and non-complying items within Work.
 2. How and by whom deficient and non-compliant items are documented "in the field."
 3. The personnel and process utilized for logging deficient and non-compliant Work at the end of each day onto a deficiency log.
 4. Tracking processes and tracking documentation for deficient and non-conforming Work.
 5. Personnel responsible for achieving resolution of outstanding deficiencies.
 6. Include detailed procedures for the performance and control of special process (e.g., welding, soldering, heat treating, cleaning, plating, nondestructive examination, etc.).
- F. Audits: The CQC program shall provide for regularly scheduled documented audits to verify that CQC procedures are being fully implemented by Contractor and its Subcontractors. Audit records shall be made available to Engineer upon request.
- G. Documented control/quality records:
1. Establish methods for control of Contract Documents that describe how Drawings and Specifications are received and distributed to ensure the correct issue of the document being used. Describe how record document/drawing data are documented and furnished to Engineer.
 2. Maintain evidence of activities affecting quality. Including operating logs, records of inspection, audit reports, personnel qualification and certification records, procedures, and document review records.
 3. Maintain quality records in a manner that provides for timely retrieval and traceability. Protect quality records from deterioration, damage and destruction.
 4. Develop a list of specific records as required by the Contract Documents that will be furnished to Engineer at the completion of activities.
- H. Acceptance of CQC Plan: Engineer's acceptance of the CQC Plan shall not relieve Contractor from any of its obligations for performance of Work. Contractor's CQC staffing is subject to Engineer's review and continued acceptance. Owner, at its sole

discretion, and without cause, may direct Contractor to remove and replace the CQC Plan Manager:

1. Acceptance of the CQC Plan by the Engineer is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction.
2. After acceptance of the CQC Plan, notify the Engineer in writing of any proposed change. Proposed changes are subject to acceptance by the Engineer.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01_45_24

REGULATORY QUALITY ASSURANCE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: This Section describes project regulatory requirements for quality assurance that includes special inspections, special certification, and structural observation.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 318 - Building Code Requirements for Structural Concrete.
 - 2. 530 - Building Code Requirements for Masonry Structures.
 - 3. 530.1 - Specification for Masonry Structures.
- B. American Institute of Steel Construction (AISC):
 - 1. 360 - Specification for Structural Steel Buildings.
- C. American Society of Civil Engineers (ASCE):
 - 1. 7 - Minimum Design Loads for Buildings and Other Structures.
- D. American Welding Society (AWS):
 - 1. D1.3 - Structural Welding Code - Sheet Steel.
 - 2. D1.4 - Structural Welding Code - Reinforcing Steel.
- E. ASTM International (ASTM):
 - 1. A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
 - 2. C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - 3. C172 - Standard Practice for Sampling Freshly Mixed Concrete.
 - 4. C1611 Standard Test Method for Slump Flow of Self-Consolidating Concrete.
- F. International Building Code (IBC) 2012.

1.03 DEFINITIONS

- A. Special Certification: Certification for designated seismic systems that demonstrates compliance with performance requirements.
- B. Special Inspection: Inspection of the materials, installation, fabrication, erection, or placement of components and connections requiring special expertise to ensure compliance with approved construction documents and referenced standards.
- C. Special Inspection, Continuous: The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.

- D. Special Inspection, Periodic: The part-time, or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed and at the completion of the work.
- E. Structural Observation: The visual observation of the structural system by a registered design professional for general conformance to the approved construction documents at significant construction stages and at completion of the structural system.

1.04 DESCRIPTION

- A. This Section describes special inspections, special certification and structural observation of structural assemblies and components to be performed in compliance with the building code specified in Section 01_41_00 - Regulatory Requirements.
- B. The special certification and special inspections specified in this Section are in addition to the requirements specified in Section 01_45_00 - Quality Control, and by the individual Sections.

1.05 SUBMITTALS

- A. Contractor shall submit special certifications for designated seismic systems.
- B. Contractor shall schedule and coordinate the submittal of Special Inspection reports and test results prepared by others.

1.06 SPECIAL INSPECTION

- A. Owner will employ 1 or more special inspectors who will provide special inspections during construction.
- B. Special inspector(s) shall be qualified for inspection of the particular type of materials or operations requiring special inspection.
- C. Testing laboratory: Testing that is required to satisfy the requirements of special inspection will be performed by the Owner's testing laboratory as specified in Section 01_45_00 - Quality Control.
- D. Duties of Special Inspector:
 - 1. General: Required duties of the special inspector(s) shall be as described in Chapter 17 of the building code specified in Section 01_41_00 - Regulatory Requirements.
 - 2. Reporting: Special inspector(s) shall provide reports of each inspection to the Contractor. Contractor shall distribute copies of inspection reports to the Owner:
 - a. Reports shall, at a minimum, include the following items:
 - 1) Date and time of inspection, and name(s) of individual(s) performing the inspection.
 - 2) Structures and areas of the structure where work or testing was observed.
 - 3) Discrepancies between the requirements of the Contract Documents and the work or testing observed.

4) Other areas of deficiency in the Work.

- E. Special inspections shall not be construed as fulfilling the requirements for structural observation.
- F. Owner or special inspector are responsible to select materials for special inspection:
 - 1. It is not acceptable for Contractor to select materials for special inspection.

1.07 SPECIAL CERTIFICATION

- A. Contractor shall be responsible for providing equipment that meets the special certification requirements of the building code specified in Section 01_41_00 - Regulatory Requirements.
- B. The following designated seismic systems shall be subject to the testing and qualification requirements of the regulatory building code, Section 1705.12.4 as specified in Section 01_41_00 - Regulatory Requirements and shall require special certification as set forth in ASCE 7, Section 13.2:
 - 1. Mechanical equipment that is assigned an importance factor of 1.50 as specified in Section 01_81_02 - Seismic Design Criteria.
 - 2. All electrical equipment.
- C. Special certification requirements for designated seismic systems:
 - 1. Submittals for mechanical and electrical equipment identified in this Section as designated seismic systems shall include certification that the equipment is seismically qualified. Certifications shall be subject to review and acceptance by Owner.
 - 2. Certifications may be at least 1 of the following in accordance with ASCE 7, Section 13.2:
 - a. Analysis.
 - b. Testing.
 - c. Experience data.

1.08 STRUCTURAL OBSERVATION

- A. Owner will employ 1 or more registered design professionals who will provide structural observation(s) during construction:
 - 1. Registered design professional shall be a civil or structural engineer currently licensed as such in the state where the project is located and regularly engaged in structural design equivalent to or similar to those indicated on the Drawings.
- B. Structural observations shall not be construed as fulfilling the requirements for special inspections.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.01 SPECIAL INSPECTIONS

- A. The Owner will provide special inspection of following types of work as described in Section 1705 of the building code as specified in Section 01_41_00 - Regulatory Requirements wherever such work occurs unless otherwise specified:
 - 1. Appendix A, Concrete - Special Inspection Schedule.
 - 2. Appendix B, Architectural, Mechanical, and Electrical Components - Special Inspection Schedule.

3.02 SPECIAL CERTIFICATION

- A. Special inspector shall examine the designated seismic system(s) specified and determine whether the designated system components, including anchorage, are consistent with the evidence of compliance submitted for special certification.

3.03 STRUCTURAL OBSERVATION

- A. The following work requires structural observation in accordance with Section 1704.5 of the building code specified in Section 01_45_00 - Regulatory Requirements:
 - 1. All structures in all areas:
 - a. Foundations.
- B. Elevated slabs.

3.04 SCHEDULE

- A. Contractor shall allow time necessary for special inspections and structural observation specified herein.
- B. Sufficient notice shall be given so that the special inspections and structural observations can be performed. Contractor shall allow time for individuals performing special inspection and structural observation to travel to the site.

3.05 PROCEDURE

- A. The special inspector will immediately notify the Engineer of any corrections required and follow notification with appropriate documentation.
- B. Contractor shall not proceed until the work is satisfactory to the Engineer.

END OF SECTION

APPENDIX A

CONCRETE SPECIAL INSPECTION SCHEDULE – SEE STRUCTURAL DRAWINGS

APPENDIX B
ARCHITECTURAL, MECHANICAL AND ELECTRICAL COMPONENTS
SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Reference Standard	Frequency of Inspection⁽¹⁾ (During Task Listed)	
	IBC 2018	Continuous	Periodic
1. Plumbing, mechanical, and electrical components:			
a. Anchorage of electrical equipment for emergency and standby power systems.	IBC: 1705.12.6.1		●
b. Anchorage of other electrical and mechanical equipment over 400 lb. on floors or roofs.	IBC: 1705.12.6.2		●
c. Installation and anchorage of pipelines carrying hazardous chemicals and their associated mechanical units.	IBC: 1705.12.6.3		●
d. Installation and anchorage of pipelines greater than 8 inches in diameter.			●
e. Installation and anchorage of ductwork designed to carry hazardous materials.	IBC: 1705.12.6.4		●
f. Installation and anchorage of ductwork greater than 6 sf in cross section.			●
g. Installation and anchorage of vibration isolation systems where contract documents require nominal clearance of 1/4 inch or less between the equipment support frame and its support/restraint.	IBC: 1705.12.6.5		●
h. Installation of mechanical and electrical equipment, including duct work, piping systems and their structural supports, where automatic fire sprinkler systems are installed.	IBC: 1705.12.6.6		●
Notes:			
(1) The "●" represents a required inspection activity for the project where it occurs.			

SECTION 01_50_00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Furnishing, maintaining, and removing construction facilities and temporary controls, including temporary utilities, construction aids, barriers and enclosures, security, access roads, temporary controls, project sign, and removal after construction.

1.02 REFERENCE

- A. American National Standards Institute (ANSI).
- B. Occupational Safety and Health Administration (OSHA).

1.03 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.

1.04 TEMPORARY UTILITIES

- A. Temporary electrical power:
 - 1. For work at the SE 40th St PRV and Metering Station: Arrange with local utility to provide adequate temporary electrical service.
 - 2. For work at Pump Station: Owner provides the power:
 - a. Temporary electrical power is available at the following locations.
 - b. The Contractor is responsible for providing breakers, switches, transformers, and cables required to obtain temporary power from these location(s).
 - c. The Owner will pay charges for construction power obtained from these locations.
 - d. Contractor shall provide electrical generator(s) as needed to operate temporary pumps as specified in this Section.
 - 3. Provide and maintain adequate jobsite power distribution facilities conforming to applicable Laws and Regulations.
 - 4. Provide, maintain, and pay for electric power for performance of the Work other than what is indicated above.
- B. Temporary electrical lighting:
 - 1. In work areas, provide temporary lighting sufficient to maintain lighting levels during working hours not less than lighting levels required by OSHA and state agency which administers OSHA regulations where Project is located.
 - 2. When available, permanent lighting facilities may be used in lieu of temporary facilities:
 - a. Prior to Substantial Completion of the Work, replace bulbs, lamps, or tubes used by Contractor for lighting.

- C. Temporary heating, cooling, and ventilating:
 - 1. Heat and ventilate work areas to protect the Work from damage by freezing, high temperatures, weather, and to provide safe environment for workers.
 - 2. Permanent heating system may be utilized when sufficiently completed to allow safe operation.

- D. Temporary water:
 - 1. Pay for and construct facilities necessary to furnish potable water for human consumption and non-potable water for use during construction. See Section 01_14_00 - Work Restrictions for further details.
 - 2. Remove temporary piping and connections and restore affected portions of the facility to original condition before Substantial Completion.
 - 3. Pay for water used for construction prior to Substantial Completion.
 - 4. Development of non-potable water supply:
 - a. Post ample signs throughout the work area warning that plant water is not potable.

- E. Temporary sanitary facilities:
 - 1. Provide suitable and adequate sanitary facilities that are in compliance with applicable Laws and Regulations.
 - 2. Existing facility use is not allowed.
 - 3. At completion of the Work, remove sanitary facilities and leave site in neat and sanitary condition.

- F. Temporary fire protection:
 - 1. Provide fire protection required to protect the Work and ancillary facilities.

- G. First aid: Post first aid facilities and information posters conforming to requirements of OSHA and other applicable Laws and Regulations in readily accessible locations.

- H. Utilities in existing facilities: As specified in Section 01_14_00 - Work Restrictions.

- I. Temporary piping systems:
 - 1. All piping and components utilized for potable water service, in contact with potable water, shall be NSF 61 certified and shall be disinfected prior to placing into service.

- J. Temporary pumping systems:
 - 1. Submit pump data, performance curves, and other operating information as specified in Section 46_05_10 - Common Work Results for Mechanical Equipment.
 - 2. Submit sketches showing layout of temporary pumping system, including pump quantity, configuration in wet well, and proposed piping layout specified in this Section.
 - 3. Submit piping headloss calculations based on proposed temporary piping system layout.
 - 4. Submit information at least 28 days prior to when the temporary pumping system is scheduled to be installed and allow 14 days for review and comment.
 - 5. All pumping components utilized for potable water service, in contact with potable water, shall be NSF 61 certified and shall be disinfected prior to placing into service.

1.05 CONSTRUCTION AIDS

- A. Provide railings, kick plates, enclosures, safety devices, and controls required by Laws and Regulations and as required for adequate protection of life and property.
- B. Use construction hoists, elevators, scaffolds, stages, shoring, and similar temporary facilities of ample size and capacity to adequately support and move loads.
- C. Design temporary supports with adequate safety factor to ensure adequate load bearing capability:
 - 1. When requested, submit design calculations by professional registered engineer prior to application of loads.
 - 2. Submitted design calculations are for information and record purposes only.
- D. Accident prevention:
 - 1. Exercise precautions throughout construction for protection of persons and property.
 - 2. Observe safety provisions of applicable Laws and Regulations.
 - 3. Guard machinery and equipment, and eliminate other hazards.
 - 4. Make reports required by authorities having jurisdiction, and permit safety inspections of the Work.
 - 5. Before commencing construction work, take necessary action to comply with provisions for safety and accident prevention.
- E. Barricades:
 - 1. Place barriers at ends of excavations and along excavations to warn pedestrian and vehicular traffic of excavations.
 - 2. Provide barriers with flashing lights after dark.
 - 3. Keep barriers in place until excavations are entirely backfilled and compacted.
 - 4. Barricade excavations to prevent persons from entering excavated areas in streets, roadways, parking lots, treatment plants, or other public or private areas.
- F. Warning devices and barricades: Adequately identify and guard hazardous areas and conditions by visual warning devices and, where necessary, physical barriers:
 - 1. Provide devices in accordance with minimum requirements of OSHA and State agency which administers OSHA regulations where Project is located.
- G. Hazards in public right-of-way:
 - 1. Comply with local jurisdiction standards and requirements for right-of-way barricades and other safety devices.
 - 2. Mark at reasonable intervals, trenches, and other continuous excavations in public right-of-way, running parallel to general flow of traffic, with traffic cones, barricades, or other suitable visual markers during daylight hours:
 - a. During hours of darkness, provide markers with torches, flashers, or other adequate lights.
 - 3. At intersections or for pits and similar excavations, where traffic may reasonably be expected to approach head on, protect excavations by continuous barricades:
 - a. During hours of darkness, provide warning lights at close intervals.
- H. Hazards in protected areas: Mark or guard excavations in areas from which public is excluded, in manner appropriate for hazard.

- I. Above grade protection: On multi-level structures, provide safety protection that meets requirements of OSHA and State agency which administers OSHA regulations where Project is located.
- J. Protect existing structures, trees, shrubs, and other items to be preserved on Project site from injury, damage, or destruction by vehicles, equipment, worker or other agents with substantial barricades or other devices commensurate with hazards.
- K. Fences:
 - 1. Enclose site of the Work with fence adequate to protect the Work against acts of theft, violence, and vandalism.
 - 2. When entire or part of site is to be permanently fenced, permanent fence may be built to serve for both permanent and temporary protection of the work site, provided that damaged or defaced fencing is replaced prior to Substantial Completion.
 - 3. Protect temporary and permanent openings and close openings in existing fences to prevent intrusion by unauthorized persons:
 - a. Bear responsibility for protection of plant and material on site of the Work when openings in existing fences are not closed.
 - 4. During night hours, weekends, holidays, and other times when no work is performed at site, provide temporary closures or enlist services of security guards to protect temporary openings.
 - 5. Fence temporary openings when openings are no longer necessary.

1.06 SECURITY

- A. Make adequate provision for protection of the work area against fire, theft, and vandalism, and for protection of public against exposure to injury.

1.07 TEMPORARY CONTROLS

- A. Dust control:
 - 1. Prevent dust nuisance caused by operations, unpaved roads, excavation, backfilling, demolition, or other activities.
 - 2. Control dust by sprinkling with water, use of dust palliatives, modification of operations, or other means acceptable to agencies having jurisdiction.
- B. Noise control:
 - 1. Comply with noise and work hours regulations by local jurisdiction.
 - 2. In or near inhabited areas, particularly residential, perform operations in manner to minimize noise.
 - 3. In residential areas, take special measures to suppress noise during night hours.
- C. Mud control:
 - 1. Prevent mud nuisance caused by construction operations, unpaved roads, excavation, backfilling, demolition, or other activities.

1.08 REMOVAL

- A. Remove temporary facilities and controls before inspection for Substantial Completion or when directed.

- B. Clean and repair damage caused by installation or use of temporary facilities.
- C. Remove underground installations to minimum depth of 24 inches and grade to match surrounding conditions.
- D. Restore existing facilities used during construction to specified or original condition.

1.09 TEMPORARY PIPING SYSTEMS

- A. Provide piping, appurtenances, and other materials as required to provide temporary piping systems as specified in this Section, as indicated on the Drawings, and as needed to perform the Work.
- B. Provide field route piping as needed and as field conditions dictate, unless otherwise indicated on the Drawings, and determine appropriate lengths of piping and quantity/type of pipe fittings needed to construct temporary piping system. Do not block access points such as stairs, doors, and walkways to existing facilities unless approved in writing by the Owner.
- C. Restrain piping at valves and at fittings where piping changes direction, changes sizes, and at ends:
 - 1. When piping is buried, use concrete thrust block or mechanical restraints.
 - 2. When piping is exposed or under water, use mechanical or structural restraints.
 - 3. Determine thrust forces by multiplying the nominal cross sectional area of the piping by the operating pressure of the piping.
- D. Install temporary piping systems in a manner that will not damage existing or new facilities.
- E. Piping material, including gaskets: Suitable for the process fluid requiring temporary piping, unless indicated otherwise.
- F. Temporary piping includes, but is not limited to, the following piping services:
 - 1. From the new tee installed in the distribution system piping to the existing 16-inch butterfly valve connecting the temporary pumping to the Pumped Pressure Zone, 16-inch PW as indicated on the Drawings and Specified.
- G. After temporary piping system is no longer required:
 - 1. Remove temporary piping system.
 - 2. Clean and repair damage caused by installation or use of temporary piping system.
 - 3. Restore existing facilities to original condition.

1.10 TEMPORARY POTABLE WATER PUMPING SYSTEMS

- A. Provide temporary potable water pumping system to pump potable water from the Reservoirs in Rotary Park to the Pumped Pressure Zone distribution system:
 - 1. Anticipated process flow rates:
 - a. Maximum: 7.2 million gallons per day (approximately 5,000 gallons per minute).

- b. Minimum: 0.3 million gallons per day (approximately 200 gallons per minute).
 2. Anticipated pressure will vary based on headlosses developed and the final length of installed temporary piping:
 - a. Calculate headlosses and provide pump with sufficient pressure to meet flow requirements.
 - b. Submit calculations sealed and signed by a professional engineer registered in the state in which the Project is located.
 - c. The pressure at the pump discharge point of connection to the facility shall be 50 psi.
 3. Provide pump capable of maintaining a set pressure through the use of variable flow rate pumping:
 - a. The use of cycled pumping (i.e., on/off) is not acceptable.
 - b. Providing a smaller variable flow rate "Jockey" pump is acceptable to meet the minimum flow requirement.
 4. Provide and pay for diesel powered generators required to operate temporary pumps. Provide and pay for the cost of diesel for use in the generators.
 5. Provide electrical and instrumentation components with applicable code requirements for the area where the temporary pump is located.
 6. Temporary pumping will be required 24 hours per day during the time period when pumping is required and is critical to the proper operation of the Owner's distribution system:
 - a. Temporary pumps shall be operated performing as required without shutdown for a minimum of 2-hours prior to taking the Main Pump Station pumps offline.
 - b. The Owner shall determine when it is acceptable to take the Main Pump Station pumps offline after successful competition of the 2-hour test.
 7. Provide 24-hour on-site supervision of pumps to ensure that pumps are always operational and performing as required:
 - a. Notify the Owner immediately if temporary pumping cannot be provided.
 8. Contractor shall be responsible for repairing any damage or reimbursing the Owner for any regulatory fines or additional plant staff time resulting from the Contractor's failure to maintain temporary pumping.
 9. Provide 100 percent backup (a.k.a., standby, redundant, etc.) pumping capacity equal to the required process flow rate:
 - a. Provide backup system capable of providing required pumping capacity immediately upon failure of primary pumping system.
 10. Provide necessary spare equipment and appurtenances on-site to allow immediate repair and/or replacement of any pumping system component that is not functioning properly.
 11. The schedule for the temporary pump system shall be considered critical path and will be coordinated with the Owner to select a time frame when demands on the system are anticipated to be low. See specification Section 01_14_00 - Work Restrictions for more details.
- B. Providing temporary piping systems as specified in this Section.
- C. After temporary process pumping system is no longer required:
 1. Remove temporary process pumping system.
 2. Clean and repair damage caused by installation or use of temporary process pumping system.
 3. Restore existing facilities to original condition.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01_56_17

EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Installation of catch basin inserts.
 - 2. Installation of erosion and sediment control filter fabric fences.
- B. Purpose of control fences is to contain pollutants from overland flow:
 - 1. Control fences are not for use in channelized flow areas.

1.02 SUBMITTALS

- A. Manufacturer's catalog sheets and other product data on geotextile fabric.

1.03 REFERENCES

- A. ASTM International (ASTM):
 - 1. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³).
 - 2. D4355 - Standard Test Method for Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus.
 - 3. D4491- Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - 4. D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - 5. D4833 - Standard Test Method for Index Puncture Resistance of Geomembranes, and Related Products.
 - 6. D5665- Standard Specification for Thermoplastic Fabrics Used in Cold-Applied Roofing and Waterproofing.
 - 7. D6459 - Standard Test Method for Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Hillslopes from Rainfall-Induced Erosion.
 - 8. D6475 - Standard Test Method for Measuring Mass per Unit Area of Erosion Control Blankets.
 - 9. D6525 - Standard Test Method for Measuring Nominal Thickness of Rolled Erosion Control Products.
 - 10. D6567 - Standard Test Method for Measuring the Light Penetration of a Rolled Erosion Control Product (RECP).
 - 11. D6818 - Standard Test Method for Ultimate Tensile Properties of Rolled Erosion Control Products.

PART 2 PRODUCTS

2.01 FILTER FABRIC

- A. Provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material.
- B. Geotextile fabric:
 - 1. Grab strength of 100 pounds per square inch in any principal direction in accordance with ASTM D4632.
 - 2. Puncture strength exceeding 115 pounds per square inch in accordance with ASTM D4833.
 - 3. Equivalent opening size between 50 and 140 for soils with more than 15 percent by weight passing No. 200 sieve and between 20 and 50 for soil with less than 15 percent by weight passing No. 200 sieve.
 - 4. Maximum water flow rate of 40 gallons per minute per square feet in accordance with ASTM D4491.
- C. Filter fabric material shall contain ultraviolet inhibitors and stabilizers to provide expected usable life comparable to anticipated construction period:
 - 1. Ultraviolet stability shall exceed 70 percent after 500 hours of exposure in accordance with ASTM D4355.
- D. Manufacturers: The following or equal:
 - 1. Mirafi, Inc.

2.02 CATCH BASIN INSERTS

- A. Provide inserts meeting requirements shown on the Drawings.
- B. Manufacturers: The following or equal:
 - 1. Siltsack by Atlantic Construction Fabrics Inc.
 - 2. StreamGuard by Foss Environmental.
 - 3. Emcom Insert by Emcom NW.
 - 4. Beaver Dam or Dandy Bag by Dandy Products.
 - 5. Envirodrain.
 - 6. Drain Warden.

PART 3 EXECUTION

3.01 PREPARATION AND INSTALLATION

- A. Provide erosion and sediment control systems at locations as indicated on the Drawings:
 - 1. Construct in accordance with requirements as indicated on the Drawings and of type indicated as specified in this Section.
- B. No clearing, grubbing or rough cutting permitted until erosion and sediment control systems are in place, other than site work specifically directed by Project Manager to allow soil testing and surveying.

- C. Maintain existing erosion and sediment control systems located within project site until acceptance of Project or until directed by Project Manager to remove and discard existing system.
- D. Regularly inspect and repair or replace damaged components of erosion and sediment control systems as specified in this Section:
 - 1. Unless otherwise directed, maintain erosion and sediment control systems until project area stabilization is accepted by the Authority.
 - 2. Remove erosion and sediment control systems promptly when directed by Project Manager.
 - 3. Discard removed materials off site.
- E. Remove and dispose sediment deposits at designated spoil site for Project:
 - 1. If a project spoil site is not indicated on the Drawings, dispose of sediment off site at location not in or adjacent to stream or floodplain.
 - 2. Assume responsibility for off-site disposal.
 - 3. Spread sediment evenly throughout site, compacted and stabilized.
 - 4. Prevent sediment from flushing into a stream or drainage way.
 - 5. If sediment has been contaminated, dispose of in accordance with existing federal, state, and local rules and regulations.
- F. Unless otherwise indicated, compact embankments, excavations, and trenches by mechanically blading, tamping, and rolling soil in maximum of 8-inch layers:
 - 1. Compaction density shall be at a minimum of 90 percent Standard Proctor ASTM D698 density.
 - 2. Make at least 1 test per 500 cubic yards of embankment.
- G. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated rights-of-way and easements for construction:
 - 1. Immediately repair damage caused by construction traffic to erosion and sediment control.

3.02 GENERAL CONSTRUCTION METHODS

- A. Provide erosion and sedimentation control systems as indicated on the Drawings:
 - 1. Install erosion and sedimentation control systems in manner that surface runoff shall percolate through system in sheet flow fashion and allow retention and accumulation of sediment.
- B. Inspect erosion and sedimentation control systems after each rainfall, daily during periods of prolonged rainfall, and at minimum once each week:
 - 1. Repair or replace damaged sections immediately.
 - 2. Remove sediment deposits when silt reaches depth 1/3 height of fence or 6 inches, whichever is less.

3.03 CATCH BASIN INSERTS

- A. Catch basin inserts shall be installed at all catch basins within project limits and those immediately downstream of the project site that could possibly receive sediment laden runoff from the site.
- B. Placing geotextile beneath a catch basin grate does not meet this standard.

3.04 FILTER FABRIC FENCE CONSTRUCTION METHODS

- A. Attach filter fabric to 1-inch by 2-inch wooden stakes or driven steel rods spaced a maximum of 3 feet apart and embedded minimum of 8 inches or deeper to hold fence in place:
 - 1. If filter fabric is factory preassembled with support netting, then maximum spacing allowable is 8 feet.
 - 2. Install anchoring stakes or rods at slight angle toward source of anticipated runoff.
 - 3. Contractor is responsible for providing adequate fence anchoring appropriate for the varying soil and rock conditions at the well sites.

- B. Trench in toe of filter fabric fence with spade or mechanical trencher so that downward face of trench is flat and perpendicular to direction of flow:
 - 1. V-trench configuration as indicated on the Drawings may also be used.
 - 2. Lay filter fabric along edges of trench.
 - 3. Backfill and compact trench.

- C. Filter fabric fence shall have a minimum height of 18 inches and a maximum height of 36 inches above natural ground.

- D. Provide filter fabric in continuous rolls and cut to length of fence to minimize use of joints:
 - 1. When joints are necessary, splice fabric together only at support post with minimum 6-inch overlap and seal securely.

END OF SECTION

SECTION 01_60_00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements for tangible materials, raw or manufactured, that become part of the project.

1.02 REFERENCES

- A. NSF International (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects.

1.03 DEFINITIONS

- A. Certificates: Describe certificates that document affirmations by the Contractor or other entity that the work is in accordance with the Contract Documents.
- B. Extra stock materials: Describe extra stock materials to be provided for the Owner's use in facility operation and maintenance.
- C. Manufacturer's instructions:
 - 1. Stipulations, directions, and/or recommendations issued in printed form by the manufacturer of the product addressing handling, installation, erection, and/or application of the product.
- D. Products:
 - 1. Raw materials, finished goods, equipment, systems, and shop fabrications.
- E. Product data:
 - 1. Public information about the product which is found in the manufacturer's catalogs or on their web site including catalog pages, data sheets, bulletins, and brochures.
- F. Samples:
 - 1. As defined in the General Conditions and Supplementary Conditions.
 - 2. Full-size actual products or pieces of products intended to illustrate the products to be incorporated into the project. Sample submittals are often necessary for such characteristics as colors, textures, and other appearance issues.
- G. Schedules:
 - 1. Product parts and materials lists.
- H. Shop drawings:
 - 1. As defined in the General Conditions and Supplementary Conditions.
 - 2. Shop drawings are prepared specifically for the project to illustrate details, dimensions, and other data necessary for satisfactory fabrication or

construction that are not shown in the contract documents. Shop drawings could include graphic line-type drawings, single-line diagrams, or schedules and lists of products and their application.

- I. Spare parts:
 - 1. Duplicate parts necessary to replace a damaged or worn part of the product.
 - 2. Consumables such as operating fluids.
- J. Special tools:
 - 1. Special wrenches, gauges, circuit setters, and other similar devices required for the proper operation or maintenance of a system that would not normally be in the Owner's tool kit and that have been specifically made for use on a product for assembly, disassembly, repair, or maintenance.
- K. Source Quality Control:
 - 1. Testing and inspections at the location of fabrication or assembly.
 - 2. Includes Factory Acceptance Testing (FAT), Factory Testing, and Source Testing.
 - 3. Test reports including the following information:
 - a. Test description.
 - b. List of equipment used.
 - c. Name of the person conducting the test.
 - d. Date and time the test was conducted.
 - e. Ambient temperature and weather conditions.
 - f. Raw data collected.
 - g. Calculated results.
 - h. Clear statement if the test passed or failed the requirements stated in Contract Documents.
 - i. Signature of the person responsible for the test.
- L. Submittals:
 - 1. As defined in the General Conditions and Supplementary Conditions.
 - 2. Samples, product data, shop drawings, and others that demonstrate how Contractor intends to conform to the Contract Documents.

1.04 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Products in contact with drinking water:
 - 1. Provide certification for by an independent ANSI accredited third party:
 - a. In accordance with NSF 61.
 - b. Weighted average lead content of less than 0.25 percent in accordance with NSF 372.

1.05 GENERAL REQUIREMENTS

- A. Comply with specified requirements.
- B. Provide products by same manufacturer when products are of similar nature, unless otherwise specified.
- C. Provide like parts of duplicate units that are interchangeable.

- D. Provide equipment or product that has not been in service prior to delivery, except as required by tests.
- E. Provide manufacturer's standard products when available.
- F. Provide products produced by manufacturers regularly engaged in the production of these products.
- G. Provide products that bear approvals and labels as specified.

1.06 SERVICES OF MANUFACTURER'S REPRESENTATIVES

- A. Qualification of manufacturer's representative as specified in the Contract Documents technical Sections include the following:
 - 1. Authorized representative of the manufacturer, factory trained and experienced in the technical applications and installation of respective products with full authority by the product manufacturer to issue the certifications required of the manufacturer.
 - 2. Competent, experienced technical representative of the product manufacturer for installation.
 - 3. Additional qualifications may be specified in the individual sections.
 - 4. Submit qualifications of the manufacturer's representative no later than 30 days in advance of required observations. Representative subject to approval by Owner and Engineer.
 - 5. No substitute representatives will be allowed until written approval by Owner and Engineer has been obtained.
- B. Completion of manufacturer on-site services:
 - 1. The manufacturer's representative will advise aspects of installation including but not limited to:
 - a. Handling.
 - b. Storing.
 - c. Cleaning and inspecting.
 - d. Coating and lining repairs.
 - e. Tapping.
 - f. General construction methods.
- C. Manufacturer is responsible for determining the time required to perform the specified services:
 - 1. No additional costs associated with performing the required services will be approved.
 - 2. Manufacturer required to schedule services in accordance with the Contractor's project schedule up to and including making multiple trips to project site when there are separate milestones associated with installation of each occurrence of manufacturer's product.
- D. Manufacturer's on-site services as specified in the Contract Documents include the following:
 - 1. Assistance during Construction.
 - 2. Provide 1 copy of daily manufacturer's representative's field notes and data to Engineer.
 - 3. Other requirements as specified in the Contract Documents.

1.07 TEST PLANNING

- A. Testing plans:
1. Provide separate testing plans for each individual product requiring field testing that include the following:
 - a. Approach to testing including procedures and schedule.
 - b. Test objective: Demonstrate product meets the design requirements as specified in the technical Sections.
 - c. Test descriptions, forms, temporary systems (pumps, piping, etc.), shutdown requirements for existing systems, test forms, test logs, witness forms, and checklists to be used to control and document the required tests.
 - d. Test forms: Include, but not limited to, the following information:
 - 1) Name of product to be tested.
 - 2) Test date.
 - 3) Names of persons conducting the test.
 - 4) Names of persons witnessing the test, where applicable.
 - 5) Test data.
 - 6) Applicable project requirements.
 - 7) Check offs for each completed test or test step.
 - 8) Place for signature of person conducting tests and for the witnessing person, as applicable.
 2. Engineer approval of test plan is required prior to performing test:
 - a. Revise and update test plans based on review comments, actual progress, or to accommodate changes in the sequence of activities.
 - b. Submit test reports for each phase of testing for each product.
 - c. Engineer approval of preceding test reports is required prior to start of next test.
 - d. Tests will be rescheduled if test plan is not approved by the required deadline:
 - 1) Contractor is responsible for any resulting delay.
 3. Contractor is responsible to reproduce and distribute final test procedures:
 - a. Provide 3 copies for Engineer.
 4. Tests may commence only after Engineer has received approved test plan copies.
 5. Submittals:
 - a. Submit test plans not less than 30 calendar days prior to planned installation testing of system.
 - b. Test procedures and forms: Provide signed-off copy of test forms and test reports upon completion of the test.
 - c. Test reports:
 - 1) Submit preliminary copies within 1 day after testing completion.
 - 2) Submit final copies and report within 14 days after testing completion.
 - d. Furnish labor, power, tools, equipment, instruments, and services required for and incidental to completing testing activities in accordance with the approved Testing Plans.
 - e. Prior to testing, verify equipment protective devices and safety devices have been installed, calibrated, and tested.

- f. Acceptable tests: Demonstrate the system performance meets the requirements stated in the Contract Documents:
 - 1) When the system fails to meet the specified requirements, perform additional, more detailed, testing to determine the cause, correct, repair, or replace the causative components and repeat the testing that revealed the deficiency.

1.08 SOURCE TESTING

- A. As specified in Section 01_45_00 - Quality Control.
- B. Also referred to as factory testing or factory acceptance testing (FAT).
- C. Test products for proper performance at point of manufacture or assembly as specified in the technical Sections.
- D. Source Test Plan:
 - 1. As specified in this Section and other technical Sections.
 - 2. Source testing requirements as specified in technical Sections:
 - a. Non-witnessed: Provide Manufacturer's Certificate of Source Testing, Section 01_75_17 - Commissioning, Appendix B.
 - 3. Prepared by Contractor as specified in the Contract Documents.
 - 4. Provide the following items for each Source Test:
 - a. Purpose and goals of the test.
 - b. Identification of each product.
 - c. Description of the pass/fail criteria that will be used.
 - d. Listing of pertinent reference documents (Contract Documents and industry standards or Sections applicable to the testing).
 - e. Complete description, including drawings or photographs, of test stands and/or test apparatus.
 - f. Credentials of test personnel.
 - g. Descriptions of test equipment to be used, product information, and all appropriate calibration records for the test equipment.
 - h. Test set-up procedures.
 - i. Detailed step-by-step test procedures:
 - 1) Provide sufficient level of detail for any witness with a rudimentary technical aptitude to be able to follow the steps and develop confidence that the tests were being performed as planned.
 - j. Sample data logs and data recording forms.
 - k. Sample computations or analyses with the results in the same format as the final report to demonstrate how data collected will be used to generate final results:
 - 1) Complete disclosure of the calculation methodologies.
 - 2) Include a sample for each type of computation required for the test and analysis of the results.
 - l. Detailed outline of the Source Test report.
 - m. Sample test reports.
 - 5. Submit Source Test Plan and forms as specified in the technical Sections:
 - a. Submit a copy of the Source Test Plan at least 21 days before any scheduled test date.
 - b. Engineer approval of Source Test Plan required prior to beginning source testing.

- c. Schedule the testing after approval of the test procedures submittal.
- E. Test results:
 - 1. Prepare and submit test results with collected data attached.

1.09 INSTALLATION TESTING

- A. Field test backfill, welded joints, alignment and grade, and pipeline pressure as specified in technical Sections.

1.10 FUNCTIONAL TESTING

- A. Notify Engineer 5 days prior to when the Work is ready for Functional Testing:
 - 1. Perform testing in the presence of the Engineer.
- B. Perform Functional Testing in addition to the other tests specified in the technical Sections:
 - 1. Contractor is responsible for providing fuel, chemicals, and other consumables needed.
- C. Repair or replace products that perform improperly and retest.
- D. Submit testing results as specified in technical Sections.

PART 2 PRODUCTS

2.01 GENERAL

- A. Material requirements:
 - 1. Materials: Provide corrosion resistance suitable for project conditions as specified in Section 01_81_01 - Project Design Criteria.
 - 2. Dissimilar metals: Separate contacting surfaces with dielectric material.
- B. Edge grinding:
 - 1. Sharp projections of cut or sheared edges of ferrous metals which are not to be welded shall be ground to a radius required to ensure satisfactory paint adherence.
- C. Provide new pipe manufactured for the project, not from manufacturer's inventory, under the following conditions:
 - 1. Pipe 24-inch diameter and larger.
 - 2. Pipe material subject to UV degradation manufactured more than 6 months prior to delivery to the project.
 - 3. Pipe with coating material subject to UV degradation manufactured more than 6 months prior to delivery to the project.
 - 4. Ductile iron pipe with cement-mortar lining manufactured more than 6 months prior to delivery to the project.
 - 5. Steel pipe 6-inch diameter and larger.
- D. Mark each length of pipe in accordance with applicable standards.

2.02 PRODUCT SELECTION

- A. When products are specified by standard or specification designations of technical societies, organizations, or associations only, provide products that meet or exceed reference standard and Specifications.
- B. When products are specified with names of manufacturers but no model numbers or catalog designations, provide:
 - 1. Products by one of named manufacturers that meet or exceed Specifications.
 - 2. Engineer deemed "or equal" evidenced by an approved shop drawing or other written communication.
- C. When products are specified with names of manufacturers and model numbers or catalog designations, provide:
 - 1. Products with model numbers or catalog designations by one of named manufacturers.
 - 2. Engineer deemed "or equal" evidenced by an approved shop drawing or other written communication.
- D. When products are specified with names of manufacturers, but with brand or trade names, model numbers, or catalog designations by one manufacturer only, provide:
 - 1. Products specified by brand or trade name, model number, or catalog designation.
 - 2. Products by one of named manufacturers proven, in accordance with requirements for an "or equal", to meet or exceed quality, appearance and performance of specified brand or trade name, model number, or catalog designation.
 - 3. Engineer deemed "or equal" evidenced by an approved shop drawing or other written communication.
- E. When Products are specified with only one manufacturer followed by "or Equal," provide:
 - 1. Products meeting or exceeding Specifications by specified manufacturer.
 - 2. Engineer deemed "or equal" evidenced by an approved shop drawing or other written communication.

2.03 SHIPMENT

- A. Requirements prior to shipment of equipment:
 - 1. Engineer approved shop drawings.
 - 2. Engineer approved Manufacturer's Certificate of Source Testing when required by specifications.
 - 3. Draft operations and maintenance manuals, as specified in Section 01_78_24 - Operation and Maintenance Manuals, when required by specifications.
- B. Prepare products for shipment by:
 - 1. Tagging or marking products to agree with delivery schedule or shop drawings.
 - 2. Including complete packing lists and bills of material with each shipment.
 - 3. Packaging products to facilitate handling and protection against damage during transit, handling, and storage.

4. Securely attach special instructions for proper field handling, storage, and installation to each piece of equipment before packaging and shipment.
- C. Transport products by methods that avoid product damage.
- D. Deliver products in undamaged condition in manufacturer's unopened containers or packaging.

2.04 SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS

- A. Provide spare parts and maintenance products as required by Technical Sections.
- B. Provide one set of special tools required to install or service the equipment.
- C. Box, tag, and clearly mark items.
- D. Contractor is responsible for spare parts, maintenance products, and special tools until acceptance by Owner.
- E. Immediately store products not to be incorporated into the work in accordance with the manufacturer's instructions.
- F. Add product to the Spare Parts, Maintenance Products, and Special Tools Inventory List - form as given in Appendix A.
- G. Store spare parts, maintenance products, and special tools in enclosed, weather-proof, and lighted facility during the construction period:
 1. Protect parts subject to deterioration, such as ferrous metal items and electrical components with appropriate lubricants, desiccants, or hermetic sealing.
- H. With Owner's written request for advanced delivery of spare parts, maintenance products, and special tools:
 1. Deliver requested items and deduct them from the inventory list.
 2. Provide transmittal documentation.
- I. Provide spare parts and special tools inventory list, see Appendix A:
 1. Equipment tag number.
 2. Equipment manufacturer.
 3. Subassembly component, if appropriate.
 4. Quantity.
 5. Storage location.
- J. Store large items individually:
 1. Weight: Greater than 50 pounds.
 2. Size: Greater than 24 inches wide by 18 inches high by 36 inches long.
 3. Clearly labeled:
 - a. Equipment tag number.
 - b. Equipment manufacturer.
 - c. Subassembly component, if appropriate.
- K. Store in spare parts box smaller items:
 1. Weight: Less than 50 pounds.

2. Size: Less than 24 inches wide by 18 inches high by 36 inches long.
 3. Clearly labeled:
 - a. Equipment tag number.
 - b. Equipment manufacturer.
 - c. Subassembly component, if appropriate.
- L. Spare parts and special tools box:
1. Box material: Waterproof, corrosion resistant.
 2. Hinged cover:
 - a. Locking hasp.
 3. Spare parts inventory list taped to underside of cover.
 4. Clearly labeled:
 - a. The words "Spare Parts and/or Special Tools".
 - b. Equipment tag number.
 - c. Equipment manufacturer.
 - d. Subassembly component, if appropriate.

PART 3 EXECUTION

3.01 DELIVERY AND HANDLING

- A. Handle equipment in accordance with manufacturer's instructions.
- B. Provide construction equipment and personnel to handle products by methods to prevent soiling or damage.
- C. Upon delivery, promptly inspect shipments:
 1. Verify compliance with Contract Documents, correct quantities, and undamaged condition of products.
 2. Acceptance of shipment does not constitute final acceptance of equipment.

3.02 STORAGE AND PROTECTION

- A. Immediately store and protect products and materials until installed in Work.
- B. Furnish covered, weather-protected storage structures providing a clean, dry, noncorrosive environment for mechanical equipment, valves, architectural items, electrical and instrumentation equipment and special equipment to be incorporated into this project:
 1. Storage of equipment shall be in strict accordance with the "instructions for storage" of each equipment supplier and manufacturer including connection of heaters, placing of storage lubricants in equipment, rotating equipment, etc.
 2. The Contractor shall furnish a copy of the manufacturer's instructions for storage to the Engineer prior to storage of equipment and materials.
 3. Maintain products within temperature and humidity ranges required or recommended by manufacturer.
- C. Store products with seals and legible labels intact.
- D. Protect painted or coated surfaces against impact, abrasion, discoloration, and damage:
 1. Repaint or recoat damaged painted or coated surfaces.

- E. Exterior storage of fabricated products:
 - 1. Place on aboveground supports that allow for drainage.
 - 2. Cover products subject to deterioration with impervious sheet covering.
 - 3. Provide ventilation to prevent condensation under covering.
- F. Store moisture sensitive products in watertight enclosures.
- G. Store loose granular materials on solid surfaces in well-drained area:
 - 1. Prevent materials mixing with foreign matter.
 - 2. Provide access for inspection.
- H. If approved by the Engineer, provide offsite storage location within 20 miles of the project site:
 - 1. Provide proof of insurance coverage for products stored offsite.
- I. Payment will not be made for equipment and materials improperly stored or stored without providing Engineer with the manufacturer's instructions for storage.
- J. Provide an equipment log and stored products log with monthly pay applications:
 - 1. Data includes as a minimum: The storage location, equipment or product identification, date stored, date of inspection/maintenance, date removed from storage, copy of manufacturer's recommended storage guidelines, description of inspection/maintenance activities performed, and signature of party performing inspection/maintenance.

3.03 PROTECTION AFTER INSTALLATION

- A. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations:
 - 1. Remove covering when no longer needed.
 - 2. Replace corroded, damaged, or deteriorated equipment, product, or parts before acceptance of the project.
- B. Update equipment log on a monthly basis with description of maintenance activities performed in accordance with the manufacturer's recommendation and industry standards and signature of party performing maintenance.

3.04 ATTACHMENTS

- A. Appendix A - Spare Parts, Maintenance Products, and Special Tools Inventory List.

END OF SECTION

APPENDIX A
SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS INVENTORY LIST

Owner: _____ Date: _____
 Contractor: _____ Project No.: _____
 Project Name: _____

Inventory List				
Spec Number: _____		Spec Title _____		
Equipment Tag No.: _____		Equipment Manufacturer: _____		
Quantity	Subassembly Component	Description	Manufacturer's Part Number	Storage Location

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SECTION 01_75_17

COMMISSIONING

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PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements for each Commissioning phase of the Project equipment/system and facility.
- B. This Section is supplementary to City of Mercer Island General Terms and Conditions.

1.02 DEFINITIONS

- A. Commissioning - The process of planning, testing, and process start-up of the installation for compliance with contract requirements and demonstrating, through documented verification, that the project has successfully met the Contractual requirements. It includes training the Owner's staff to operate the facility.
- B. Commissioning Phases - The work activities of facility commissioning are grouped into the phases defined in the table below.

<u>Commissioning</u>		
<u>Planning Phase</u>	<u>Testing and Training Phase</u>	<u>Process Start-Up Phase</u>
Owner Training Plan and Schedule	Source Testing	Process Start-up
Commissioning Schedule	Owner Training	Process Operational Period
Subsystem Testing Plan	Installation Testing	
	Functional Testing	
	Closeout Documentation	

- C. Component - A basic building block of equipment, subsystems, and systems that requires installation or functional testing but does not have an electrical connection or internal electronics. (Examples: piping and manual isolation valves).
- D. Device - A basic building block of equipment, subsystems, and systems that requires installation or functional testing and does have an electrical connection or internal electronics. (Examples: level transmitter or water pump pressure transmitter).
- E. Equipment - An assembly of component(s) and devices(s) that requires installation or functional testing. (Examples: Pump, motor, VFD, Onsite Sodium Hypochlorite Generator, Chemical Metering Pump, etc.).
- F. Facility or Process Area - A grouping of systems, subsystems, equipment, components, and devices (Examples: Main Pump Station etc.).

- G. Functional Testing - Testing performed on a completed subsystem to demonstrate that equipment/system meets manufacturers' calibration and adjustment requirements and other requirements as specified. Functional testing includes operating equipment/system manually in local, manually in remote (or remote manual), and automatically in remote (in remote auto).
- H. Installation Testing - Testing to demonstrate that subsystem component (piping, power, networks, devices, etc.) is ready and meets the project requirements in advance of functional testing. Installation testing also includes manufacturers' certification of installation and other requirements as specified to prepare equipment/system for Functional Testing. Also referred to as Field Acceptance Testing.
- I. Manufacturer's Certificate of Source Testing - When applicable, the form is used during Source Testing for the manufacturer to confirm that the applicable source tests have been performed and results conform to the Contract Documents. The form is provided at the end of this Section.
- J. Manufacturer's Certificate of Installation and Functionality Compliance - The form is used during Installation Testing and Functional Testing. It is submitted at the end of Functional Testing to confirm that the equipment/system is installed in conformance with the Contract Documents and that it meets the Functional Testing requirements defined in the Contract Documents. The form is provided at the end of this Section.
- K. Process Operational Period - A period of time after completion of the process start-up set aside for final Operational Testing to verify facility performance meets the Contract Document requirements. This period may specifically limit other construction activities.
- L. Process Start-up Phase - Operating the facility to verify performance meets the Contract Document requirements.
- M. Process Start-Up - Activities conducted after the testing and training phase that are necessary to place systems or process areas into operational service.
- N. Product - A system, subsystem or component.
- O. Subsystem - A building block of systems made up from a grouping of components, devices, and equipment that perform a definable function. (Examples: Onsite Sodium Hypochlorite Generation System, Chlorine Injection).
- P. System - A grouping of subsystems, equipment, components, and devices that perform a definable function. (Examples: Chlorine Boosting System).

1.03 SUBMITTALS

- A. Qualifications:
 - 1. Commissioning Coordinator's qualifications.
 - 2. Manufacturer's representative's qualifications.
- B. Schedules:
 - 1. Owner Training Plan Schedule.
 - 2. Commissioning Schedule.

- C. Certificates:
 - 1. Manufacturer's Certificate of Source Testing.
 - 2. Manufacturer's Certificate of Installation and Functionality Compliance.
- D. Reports:
 - 1. Test reports.
- E. Plans:
 - 1. Owner Training Plan.
 - 2. Source Test Plan.
 - 3. Installation and Functional Testing Plan:
 - a. Subsystem Testing Plans.
 - 4. Process Start-Up Plan:
 - a. Process Start-Up.
 - b. Process Operational Period.
 - 5. Final Operational Testing Plan.
- F. Documentation:
 - 1. Preliminary documentation.
 - 2. Final documentation.
 - 3. Closeout documentation.

1.04 COMMISSIONING COORDINATOR (CC)

- A. Designate and provide a CC for this project:
 - 1. Submit summary of the CC's qualifications within 30 days of NTP:
 - a. Include description of previous experience as a CC on similar projects for the designated CC with a list of references including phone numbers for review and Owner approval.
 - 2. The CC must have minimum of 10 years of experience in similar construction projects.
- B. CC responsibilities include the following:
 - 1. Lead efforts relating to Commissioning.
 - 2. Be thoroughly familiar with commissioning requirements in the Contract Documents.
 - 3. Be regularly engaged and experienced in all aspects of commissioning.
 - 4. Provide technical instruction for commissioning.
 - 5. Provide primary interface with Engineer and Owner for efforts relating to Commissioning of Project facilities.
 - 6. Coordinate training efforts.

1.05 SERVICES OF MANUFACTURER'S REPRESENTATIVES

- A. Qualification of manufacturer's representative as specified in the Contract Documents technical sections include the following:
 - 1. Authorized representative of the manufacturer, factory trained and experienced in the technical applications, installation, operation, and maintenance of respective equipment/system with full authority by the equipment/system manufacturer to issue the certifications required of the manufacturer.
 - 2. Competent, experienced technical representative of equipment/system manufacturer for assembly, installation, testing guidance, and training.

3. Additional qualifications may be specified in the individual sections.
 4. Submit qualifications of the manufacturer's representative no later than 30 days in advance of required observations.
 5. Representative subject to approval by Owner and Engineer.
 6. No substitute representatives will be allowed until written approval by Owner and Engineer has been obtained.
- B. Manufacturer is responsible for determining the time required to perform the specified services:
1. Minimum times specified in the Contract Documents are estimates.
 2. No additional costs associated with performing the required services will be approved.
 3. Manufacturer required to schedule services in accordance with the Contractor's project schedule up to and including making multiple trips to project site when there are separate milestones associated with installation of each occurrence of manufacturer's equipment.
- C. Manufacturer's on-site services as specified in the Contract Documents include the following:
1. Assistance during Commissioning Phase and Process Start-Up Phase.
 2. Provide weekly copies of manufacturer's representatives field notes and data to Engineer.
 3. Other requirements as specified in the Contract Documents.

1.06 PLANNING PHASE

- A. Overview of Planning Phase:
1. Define approach and timing for Commissioning.
- B. Owner training plan and schedule:
1. Training outcomes:
 - a. Owner's operations, maintenance, and engineering staff have the information needed to safely operate, maintain, and repair the equipment/systems provided in the Contract Documents.
 2. Training objectives:
 - a. To instruct personnel in the operation and maintenance of the equipment/system. Instruction shall include step-by-step troubleshooting procedures with all necessary test equipment/system.
 - b. To instruct personnel in the removal, inspection, and cleaning of equipment/system as needed.
 - c. Training tailored to the skills and job classifications of the staff attending the classes (e.g., plant superintendent, treatment plant operator, maintenance technician, electrician, etc.).
 - d. Provide supporting documentation, such as vendor operation and maintenance manuals.
 3. Training schedule:
 - a. Schedule Owner's staff training within the constraints of their workloads. Those who will participate in this training have existing full-time work assignments, and training is an additional assigned work task, therefore, scheduling is imperative. Owner staff work schedules regularly shift, as treatment facilities are typically operated on an around-the-clock basis.

4. Training plan:
 - a. Coordinate and arrange for manufacturer's representatives to provide both classroom-based learning and field (hands-on) training, based on training module content and stated learning objectives.
 - b. Conduct classroom training at location designated by Owner.
 - c. Scope and sequence:
 - 1) Plan and schedule training in the correct sequence to provide prerequisite knowledge and skills to trainees:
 - a) Describe recommended procedures to check/test equipment/system following a corrective maintenance repair.
5. Training scheduling coordination:
 - a. CC is responsible for the following:
 - 1) Coordinate schedule for training periods with the Owner's personnel and manufacturer's representatives (instructors).
 - b. Complete Owner training no sooner than 15 calendar days prior to start of process start-up of each system.
6. Meetings:
 - a. CC is responsible for setting commissioning coordination meeting dates and times, as well as preparing the agendas and meeting minutes.
 - b. CC shall meet with Engineer and Owner's designated training coordinator to develop list of personnel to be trained and to establish expected training outcomes and objectives at least 60 calendar days prior to commissioning of equipment/system.
 - c. CC shall conduct commissioning progress meetings throughout construction, to plan, scope, coordinate, and schedule future activities, resolve problems, etc.:
 - 1) Frequency: Monthly minimum. Increase frequency as needed based on complexity and quantity of commissioning activities.
7. Submittals:
 - a. Submit Training Plan Schedule 30 calendar days before the first scheduled training session, including but not limited to lesson plans, participant materials, instructor's resumes, and training delivery schedules.
 - b. Submit training documentation including the following:
 - 1) Training plan:
 - a) Training modules.
 - b) Scope and sequence statement.
 - c) Contact information for manufacturer's instructors including name, phone, and e-mail address.
 - d) Instructor qualifications.
 - 2) Training program schedule:
 - a) Format: Bar chart:
 - (1) Additionally include in the Project Progress Schedule.
 - b) Contents:
 - (1) Training modules and classes.
8. Training sessions:
 - a. Provide training sessions for equipment/system as specified in the individual equipment/system section.

- C. Commissioning Schedule:
 - 1. Commissioning overview:
 - a. Comply with Commissioning Roles and Responsibilities Matrix specified at the end of this Section.
 - 2. Submittal due date:
 - a. Submit Commissioning Schedule not less than 30 calendar days prior to planned initial commissioning of each subsystem or system.
 - 3. Schedule requirements:
 - a. Schedule durations and float for commissioning activities to ensure Work does not fall behind schedule due to complications or delays during commissioning.
 - b. Time-scaled network diagram detailing the work to take place in the period between 210 calendar days prior to planned initial commissioning of equipment and systems, and prior to the date of Substantial Completion, together with supporting narrative.
 - c. Provide detailed schedule of commissioning activities including durations and sequencing requirements:
 - 1) Identify the following activities:
 - a) Testing and Training Phase:
 - (1) Source Testing.
 - (2) Owner Training.
 - (3) Installation Testing.
 - (4) Functional Testing.
 - (5) Closeout Documentation.
 - b) Process Start-Up Phase:
 - (1) Process Start-Up.
 - (2) Process Operational Period.
 - d. Schedule manufacturer's services to avoid conflict with other on-site testing or other manufacturers' on-site services.
 - e. Verify that conditions necessary to allow successful testing have been met before scheduling services.
- D. Installation and Functional Testing Plan:
 - 1. Submit Installation and Functional Testing Plan.
 - 2. Subsystem testing plans:
 - a. Submit separate testing plans for each individual subsystem and system that include the following:
 - 1) Approach to testing including procedures, schedule, and recirculation requirements.
 - 2) Test objective: Demonstrate subsystem meets the design requirements as specified in the technical sections.
 - 3) Test descriptions, forms, temporary systems (pumps, piping, etc.), shutdown requirements for existing systems, test forms, test logs, witness forms, and checklists to be used to control and document the required tests.
 - 4) Test forms: Include, but not limited to, the following information:
 - a) Tag and name of equipment/system to be tested.
 - b) Test date.
 - c) Names of persons conducting the test.
 - d) Names of persons witnessing the test, where applicable.
 - e) Test data.
 - f) Applicable project requirements.

- g) Check offs for each completed test or test step.
 - h) Place for signature of person conducting tests and for the witnessing person, as applicable.
- 5) Define start-up sequencing of unit processes:
- a) Include testing of alarms, interlocks, permissives, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters.
 - b) Provide detailed test procedures setting forth step-by-step descriptions of the procedures for systematic testing of equipment/system.
 - c) Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration:
 - (1) Perform initial checks in the presence of and with the assistance of the manufacturer's representative.
 - d) Demonstrate proper operation of each control loop function including mechanical, electrical, alarms, local and remote controls, instrumentation, and other equipment/system functions:
 - (1) Generate signals with test equipment/system to simulate operating conditions in each control mode.
- b. Engineer approval of test plan is required prior to performing test:
- 1) Revise and update test plans based on review comments, actual progress, or to accommodate changes in the sequence of activities.
 - 2) Submit test reports for each phase of testing for each equipment/system.
 - 3) Engineer approval of preceding test reports is required prior to start of next test.
 - 4) Tests will be rescheduled if test plan is not approved by the required deadline:
 - a) Contractor is responsible for any resulting delay.
- c. Contractor is responsible to reproduce and distribute final test procedures:
- 1) Provide 3 copies for Engineer.
- d. Tests may commence only after Engineer has received approved test plan copies.
- e. Submittals:
- 1) Submit test plans not less than 30 calendar days prior to planned installation testing of subsystem or system.
 - 2) Completed Manufacturer's Certificate of Installation and Functionality Compliance.
 - 3) Test procedures and forms: Provide signed-off copy of test forms and test reports upon completion of the test.
 - 4) Test reports:
 - a) Submit preliminary copies within 1 day after testing completion.
 - b) Submit final copies and report within 14 days after testing completion.

1.07 TESTING AND TRAINING PHASE

- A. Overview of Testing and Training Phase:
1. General:
 - a. Include specified Source Testing, Owner Training, Installation Testing, Functional Testing, and Closeout Documentation required by this Section and the technical sections.
 2. Contractor responsibilities:
 - a. Furnish labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing commissioning activities in accordance with the approved Commissioning Plans.
 - b. Prior to testing, verify equipment protective devices and safety devices have been installed, calibrated, and tested.
 - c. Acceptable tests: Demonstrate the equipment/system performance meets the requirements stated in the Contract Documents:
 - 1) When the equipment/system fails to meet the specified requirements, perform additional, more detailed, testing to determine the cause, correct, repair, or replace the causative components and repeat the testing that revealed the deficiency.
- B. Source testing:
1. Also referred to as factory testing or factory acceptance testing (FAT).
 2. Test components, devices, and equipment/system for proper performance at point of manufacture or assembly as specified in the technical sections.
 3. Notify the Engineer in writing when the equipment/system is ready for source inspection and testing.
 4. Source Test Plan:
 - a. As specified in this Section and other technical sections.
 - b. Source testing requirements as specified in technical sections:
 - 1) Non-witnessed: Provide Manufacturer's Certificate of Source Testing.
 - c. Provide the following items for each Source Test:
 - 1) Purpose and goals of the test.
 - 2) Identification of each item of equipment/system, including system designation, location, tag number, control loop identifier, etc.
 - 3) Description of the pass/fail criteria that will be used.
 - 4) Listing of pertinent reference documents (Contract Documents and industry standards or sections applicable to the testing).
 - 5) Complete description, including drawings or photographs, of test stands and/or test apparatus.
 - 6) Credentials of test personnel.
 - 7) Descriptions of test equipment to be used, product information, and all appropriate calibration records for the test equipment.
 - 8) Test set-up procedures.
 - 9) Detailed step-by-step test procedures:
 - a) The level of detail shall be sufficient for any witness with a rudimentary technical aptitude to be able to follow the steps and develop confidence that the tests were being performed as planned.
 - b) All steps are significant, and all steps shall be included in the procedures.
 - 10) Sample data logs and data recording forms.

- 11) Sample computations or analyses with the results in the same format as the final report to demonstrate how data collected will be used to generate final results:
 - a) Complete disclosure of the calculation methodologies.
 - b) Include a sample for each type of computation required for the test and analysis of the results.
 - 12) Detailed outline of the Source Test report.
 - 13) Sample test reports.
5. Test results:
- a. Prepare and submit test results with collected data attached.
- C. Owner training:
1. Training instruction format:
 - a. The training for operations and maintenance personnel shall be provided as one entity.
 - b. Instructors shall apply adult education best practices, emphasizing learner participation and activity.
 - c. Training delivery may include problem solving, question/answer, hands-on instruction, practice, evaluation/feedback tools, and lecture.
 - d. Visual aids and hands-on practice sessions must support training objectives.
 - e. Lecturing should be less than 30 percent of class time.
 - f. Conduct hands-on instruction according to the following descriptions:
 - 1) Present hands-on demonstrations of at least the following tasks:
 - a) Proper start-up, shutdown, and normal and alternative operating strategies.
 - b) Common corrective maintenance repairs for each group.
 - c) Recommended procedures to check/test equipment/system following a corrective maintenance repair.
 - d) Preventative maintenance points.
 - e) Calibration, if applicable.
 - 2) Use tools and equipment provided by manufacturer to conduct the demonstrations:
 - a) Submit requests for supplemental assistance and facilities with the Contractor's proposed lesson plans.
 - 3) Contractor remains responsible for equipment disassembly or assembly during hands-on training situations involving equipment disassembly or assembly by Owner's personnel.
 2. Class agenda:
 - a. Include the following information in the agenda:
 - 1) Instructor name.
 - 2) Listing of subjects to be discussed.
 - 3) Time estimated for each subject.
 - 4) Allocation of time for Owner staff to ask questions and discuss the subject matter.
 - 5) List of documentation to be used or provided to support training.
 - b. Owner may request that particular subjects be emphasized and the agenda be adjusted to accommodate these requests.
 - c. Distribute copies of the agenda to each student at the beginning of each training class.

3. Number of students:
 - a. Estimated maximum class size: 5 persons:
 - 1) Owner will determine the actual number of students.
 - 2) Engineer will provide an estimated headcount 1 week prior to the class, so that the instructor can provide the correct number of training aids for students.
4. Instructor qualifications:
 - a. Provide instructors completely knowledgeable in the equipment/system for which they are training.
 - b. Provide instructors experienced in conducting classes.
 - c. Provide instructor's technical preparation and instructional technology skills and experience.
 - d. Sales representatives are not qualified instructors unless they possess the detailed operating and maintenance knowledge required for proper class instruction.
 - e. If, in the opinion of the Owner, an appropriately knowledgeable person did not provide the scheduled training, such training shall be rescheduled and repeated with a suitable instructor.
5. Classroom documentation:
 - a. Trainees will keep training materials and documentation after the session.
 - b. Operations and maintenance manuals, as specified in technical sections:
 - 1) Provide the quantity final Engineer-approved operations and maintenance manuals as specified in Section 01_78_24 - Operation and Maintenance Manuals for use during the classroom instruction.
 - 2) Owner reserves the right to delay training for a particular equipment item if the operations and maintenance manuals for that equipment are incomplete, inaccurate, or otherwise unsuitable for use by the Owner's staff.
 - 3) No contract extensions or extra costs will be allowed for training delays due to operations and maintenance manual submittal delays.
 - c. Provide supplemental documentation handouts to support instruction.
 - d. Training modules:
 - 1) Provide a training module for each equipment category.
 - 2) Divide each training module's instructional content into discrete lesson plans.
 - e. Lesson plans:
 - 1) Provide performance-based learning objectives.
 - 2) State learning objectives in terms of what the trainees will be able to do at the end of the lesson.
 - 3) Define student conditions of performance and criteria for evaluating instructional success.
 - 4) Instruction lesson plan outlines for each trade:
 - a) Provide specific components and procedures.
 - 5) Minimum requirements:
 - a) Hands-on demonstrations planned for the instructions.
 - b) Cross-reference training aids.
 - c) Planned training strategies such as whiteboard work, instructor questions, and discussion points or other planned classroom or field strategies.
 - d) Attach handouts cross-referenced by section or topic in the lesson plan.
 - e) Indicate duration of outlined training segments.

- 6) Provide maintenance instruction lesson plans including:
 - a) Equipment operation:
 - (1) Describe equipment's operating (process) function and system theory.
 - (2) Describe equipment's fundamental operating principles and dynamics.
 - (3) Identify equipment's mechanical, electrical, and electronic components and features.
 - (4) Identify support equipment associated with the operation of subject equipment.
 - (5) Detail the relationship of each piece of equipment or component to the subsystems, systems, and process.
 - (6) Cite hazards associated with the operations, exposure to chemicals associated with the component, or the waste stream handled by the component.
 - (7) Specify appropriate safety precautions, equipment, and procedures to eliminate, reduce, or overcome hazards.
 - b) Detailed component description:
 - (1) Define Preventative Maintenance (PM) inspection procedures required on equipment in operation, spot potential trouble symptoms (anticipate breakdowns), and forecast maintenance requirements (predictive maintenance):
 - (a) Review preventive maintenance frequency and task analysis table.
 - (2) Identify each component function and describe in detail.
 - (3) Where applicable, group relative components into subsystems.
 - (4) Identify and describe in detail equipment safety features, permissive and controls interlocks.
- 7) Provide the following information in equipment troubleshooting lesson plans:
 - a) Define recommended systematic troubleshooting procedures as they relate to specific craft problems.
 - b) Provide component specific troubleshooting checklists as they relate to specific craft problems.
- 8) Provide the following information in equipment Corrective Maintenance (CM) troubleshooting lesson:
 - a) Describe recommended equipment preparation requirements as they relate to specific craft problems.
 - b) Identify and describe the use of any special tools required for maintenance of the equipment as they relate to specific craft problems.
 - c) Describe component removal/installation and disassembly/assembly procedures for specific craft repairs.
 - d) Perform at least 2 hands-on demonstrations of common corrective maintenance repairs:
 - (1) Additional demonstrations may be required by the Owner.
 - e) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.

- f. Schedule specific sessions:
 - 1) Minimum of 30 days in advance to allow Owner staffing arrangements to take place.
 - 2) Owner approval and confirmation required for session schedules.
- 6. Submittals:
 - a. Prior to the training session:
 - 1) Instructor qualifications: Due 30 calendar days prior to initial training session.
 - 2) Training course materials: Due 14 calendar days prior to initial training session:
 - a) Training agenda, lesson plan, presentation, and handouts.
 - b) Other audio-visual aids utilized during each training course.
 - c) Format: 2 electronic copies and 3 hard copies organized in notebooks.
 - b. Post training session:
 - 1) Training course materials: Due 14 calendar days after class completion:
 - a) Class attendance sheet.
 - b) Training agenda, final lesson plan, presentation, and handouts.
 - c) Other audio-visual aids utilized during each training course.
 - d) Provide materials for all sessions of the class in a single transmittal.
 - e) Format: 2 electronic copies and 3 hard copies organized in notebooks.

D. Installation Testing:

- 1. Perform subsystem testing according to approved Subsystem Testing Plans.
- 2. Initiate the Manufacturer's Certificate of Installation and Functionality Compliance for all equipment:
 - a. Manufacturer's Certificate of Installation and Functionality Compliance form is included in this Section.
 - b. Manufacturer's Certificate of Installation and Functionality Compliance certifies the equipment meets the following requirements:
 - 1) Has been properly installed, adjusted, aligned, and lubricated.
 - 2) Is free of any stresses imposed by connecting piping or anchor bolts.
 - 3) Is able to be operated as necessary for Functional Testing.
 - c. Form shall be submitted after completion of Functional Testing, as specified in this Section.
- 3. Coordinate Installation Testing with restrictions and requirements as specified in Section 01_14_00 - Work Restrictions.
- 4. Perform coating holiday testing as specified in Section 09_96_01 - High-Performance Coatings.
- 5. Perform pressure and leakage testing as specified in individual component Sections and Section 40_05_00.09 - Piping Systems Testing.
- 6. Perform mechanical equipment Installation Testing: As specified below and in individual equipment sections, such as Section 46_05_10 - Common Work Results for Mechanical Equipment and Section 46_05_94 - Mechanical Equipment Testing:
 - a. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.
 - b. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.

- c. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.
 - d. Perform cold alignment and hot alignment to manufacturer's tolerances.
 - e. Inspect hand and motorized valves for proper adjustment:
 - 1) Tighten packing glands to ensure no leakage, but permit valve stems to rotate without galling.
 - 2) Verify valve seats are positioned for proper flow direction.
 - f. Tighten leaking flanges or replace flange gasket:
 - 1) Inspect screwed joints for leakage.
 - g. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to operational testing.
7. Electrical devices and subsystems Installation Testing: As specified in the electrical technical sections.
 8. Instrumentation devices and subsystems Installation Testing: As specified in the instrumentation technical sections.
- E. Functional Testing:
1. Prerequisite: Successful completion with Engineer approval of Installation Testing.
 2. Complete valve and gate labeling as specified in Section 40_05_00.03 - Pipe Identification prior to the start of Functional Testing.
 3. Perform subsystem testing according to approved Subsystem Testing Plan:
 - a. Heating, ventilating, and air conditioning systems.
 4. Notify the Engineer 5 days prior to when the Work is ready for Functional Testing:
 - a. Perform testing in the presence of the Engineer.
 5. Determine Functional Testing durations with Owner's input:
 - a. Durations will vary depending on the availability of water for testing.
 - b. Target minimum Functional Test duration: 8 hours:
 - 1) Identify equipment/system that cannot be tested for a minimum of 8 hours as specified in technical sections.
 6. Perform Functional Testing as specified in technical sections:
 - a. Perform Functional Testing in addition to the other tests specified in the technical sections.
 - b. Perform Functional Testing to demonstrate that the component equipment functions as an entire system in accordance with the design requirements.
 - c. Perform Functional Testing to demonstrate that the unit process has operated in a manner necessary to demonstrate equipment/system functions manually in local, manually in remote (or remote manual), and automatically in remote (in remote auto).
 - d. Perform testing with Contractor-provided water.
 - e. Repair or replace parts that operate improperly and retest.
 - f. Submit testing reports as specified in the technical sections to the Owner and Engineer for approval of Functional Testing reports.
 7. Provide completed Manufacturer's Certificate of Installation and Functionality Compliance forms for all equipment:
 - a. Manufacturer's Certificate of Installation and Functionality Compliance form is included in this Section.
 - b. Manufacturer's Certificate of Installation and Functionality Compliance certifies the equipment/system meets the following requirements:
 - 1) Is suitable for satisfactory full-time operation under full-load conditions.

- 2) Operates within the allowable limits for vibration and noise.
- 3) Electrical and instrumentation requirements:
 - a) Electrical equipment, instrumentation, and control panels are properly installed, calibrated, and functioning.
 - b) Electrical Installation Testing is complete, and test results have been approved by the Engineer:
 - (1) Noted deficiencies have been corrected.
 - (2) Relays, circuit breakers, and other protective devices are set.
 - c) Control logic for start-up, shutdown, sequencing, interlocks, control, and emergency shutdown has been tested and is properly functioning.
 - d) Motor control is calibrated and tested.

F. Closeout documentation submittals:

1. Provide records generated during Commissioning Phase of Project including but not limited to:
 - a. Training documentation.
 - b. Manufacturer's Certificate of Source Testing.
 - c. Manufacturer's Certificate of Installation and Functionality Compliance.
 - d. Daily logs of equipment/system testing identifying tests conducted and outcome.
 - e. Test forms and documentation.
 - f. Functional Testing results.
 - g. Logs of time spent by manufacturer's representatives performing services on the job site.
 - h. Equipment lubrication records.
 - i. Electrical phase, voltage, and amperage measurements.
 - j. Insulation resistance measurements.
 - k. Bearing temperature measurements.
 - l. Data sheets of control loop testing including testing and calibration of instrumentation devices and setpoints.
 - m. Provide: 2 electronic copies and 3 hard copies organized in notebooks.
 - n. Due date: Within 14 calendar days of Substantial Completion.

1.08 PROCESS START-UP PHASE

A. Overview of Process Start-Up Phase:

1. Operating the facility to verify performance meets the Contract Document requirements.

B. Process Start-Up:

1. Perform process start-up in the presence of the Engineer.
2. Pre-start-up activities and submittals:
 - a. Commissioning Documentation and Data Review.
 - b. Start-Up Go/No-Go Decision Criteria.
 - c. Building and Fire Inspection Compliance Check.
 - d. Process Start-Up Sequence Review.
 - e. Process Start-Up plan for review by Engineer not less than 30 calendar days prior to planned commencement of process start-up activities:
 - 1) Include the following:
 - a) Pre-start-up activities.

- b) Process Start-Up.
 - c) Process Operational Period.
 - f. Description of Temporary Testing Arrangement, if applicable.
 - g. Final Process Start-Up Forms and Documentations.
 - h. Final Operational Testing Plan.
 - 3. Control loop tuning:
 - a. Perform control loop tuning during system testing with water to the extent possible.
 - 4. Process area start-ups:
 - a. Process start-up individual process areas comprised of multiple interdependent systems where possible and beneficial to reduce complexity and risk of complete facility testing.
 - b. Process area test flows may be limited by upstream and downstream process constraints (i.e., tank and basin volumes) and/or localized recirculation capabilities.
 - 5. Facility-wide process start-up:
 - a. Upon approved completion of pre-start-up activities, perform entire facility process start-up:
 - 1) Complete control loop tuning during this phase of process start-up.
 - 2) Continue process start-up operations until facility meets or exceeds the Contract requirements.
 - b. Remaining equipment/system tests:
 - 1) Conduct remaining specified equipment/system performance tests that could not be performed during the Testing and Training Phase due to inter-system and/or treatment process dependencies.
- C. Process Operational Period:
1. Prerequisite: Successful completion with Engineer approval of Process Start-Up.
 2. Prior to beginning the Process Operational Period:
 - a. Conformance with treatment standards is required prior to Operational Testing, if applicable.
 - b. Correct any outstanding punch list items prior to the Operational Testing.
 3. Duration: 30 calendar days.
 4. Engineer will be present for process operational period unless such presence is expressly waived in writing.
 5. Prove facility conformance with Contract Document requirements.
 6. Contractor to provide:
 - a. Specified start-up materials and operating supplies.
 - b. Necessary craft of labor assistance, in the event of an emergency equipment failure requiring immediate attention (emergency is defined as a failure of function which precludes the further operation of a critical segment of or the whole of the Work) with a response time of not more than 4 hours from the time of notification.
 - c. Manufacturer's authorized representative to supervise placing equipment/systems in operation and provide guidance during Operational Testing per applicable section.
 - d. Necessary manufacturer's representatives and operating supplies for retesting systems that fail to pass the initial Operational Testing due to deficiencies in products of workmanship at no additional cost to the Owner.

- e. List of 24-hour "on-call" representative supervisory persons who will monitor the Operational Testing and serve as liaison for the Engineer and Owner.
- 7. Owner will provide:
 - a. Operations personnel for duration of test.
- 8. Contractor's CC shall oversee Process Operational Period:
 - a. Owner staff will operate the completed Project construction.
 - b. Entire system shall continuously meet performance requirements and shall operate without fault, failure, or defect for a continuous period.
 - c. Individual equipment/system failures that are corrected within 24 hours and do not prevent the entire project from continuously satisfying the established operational requirements shall not require the consecutive day test to be restarted unless the failure recurs.
 - d. Restart the consecutive test period for any of the following conditions:
 - 1) Any failure of the complete Project construction to meet operational requirements.
 - 2) When malfunctions or deficiencies cause shutdown or partial operation of the facility, or results in failure of the complete Project construction to meet operational requirements.
 - 3) Any individual equipment/system failure that meets any of the following conditions:
 - a) Requires more than 24 hours to correct.
 - b) Recurs within the 24-hour correction period requiring further correction.
 - 4) Immediately correct defects in material, workmanship, or equipment/system which became evident during Operational Testing.
- 9. Permitting approval of Process Operational Period results required for Substantial Completion.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

MANUFACTURER'S CERTIFICATE OF SOURCE TESTING

OWNER _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

Comments: _____

I hereby certify Source Testing has been performed on the above-referenced equipment/system as defined in the Contract Documents, and results conform to the Contract Document requirements. Testing data is attached.

Date of Execution: _____, 20____

Manufacturer: _____

Manufacturer's Authorized Representative Name (*print*): _____

(Authorized Signature)

If applicable, Witness Name (*print*): _____

(Witness Signature)

**MANUFACTURER'S CERTIFICATE OF
INSTALLATION AND FUNCTIONALITY COMPLIANCE**

OWNER _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

I hereby certify the installation and function of the above-referenced equipment/system as defined in the Contract Documents. The above-referenced equipment/system has been: (Check Applicable)

- Installed in accordance with manufacturer's recommendations.
- Inspected, checked, and adjusted.
- Serviced with proper initial lubricants.
- Electrical/instrumentation and mechanical connections meet quality and safety standards.
- All applicable safety equipment has been properly installed.
- Functionally tested.
- System has been performance tested, and meets or exceeds specified performance requirements.

NOTES:

Attach test results with collected data and test report.

Attach written certification report prepared by and signed by the electrical and/or instrumentation subcontractor.

Comments: _____

I, the undersigned manufacturer's representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate this equipment/system, and (iii) authorized to make recommendations required to ensure that the equipment/system furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____

Manufacturer: _____

Manufacturer's Authorized Representative Name (*print*): _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

COMMISSIONING ROLES AND RESPONSIBILITIES MATRIX

NO.	TASK	OWNER	CONTRACTOR	ENGINEER
Testing and Training Phase				
Source Testing				
1	Source Testing	No Action	Lead	Review
Installation Testing				
2	Electrical Conductor Testing	No Action	Lead	Witness
3	Electrical Field Acceptance Tests	No Action	Lead	Witness
4	Instrument Field Calibration	No Action	Lead	Witness
5	Network Installation Testing	Witness	Lead	Witness
6	Loop Testing	No Action	Lead	Witness
7	Pressure Testing	No Action	Lead	Witness
8	Leak Testing	No Action	Lead	Witness
9	Holiday Testing	No Action	Lead	Witness
10	HVAC Testing	No Action	Lead	Witness
11	Motor Electrical Testing	No Action	Lead	Witness
Functional Testing				
12	Network Operational Testing	Witness	Lead	Review
13	Preliminary Run Testing Local/Manual Control	Witness	Lead	Review
14	PCIS Functional Demonstration Testing - Local/Auto Control Testing - Remote/Manual Contact Testing - Alarm Testing - Control Loop Testing	No Action	Lead	Review
15	Subsystem Start-Up and Testing	Witness	Lead	Review
16	Equipment/System Start-Up and Testing	Witness	Lead	Review
17	HVAC Start-Up and Testing	Witness	Lead	Review
18	Corrosion Control Start-Up and Testing	Witness	Lead	Review
19	Wide Area Network Communications Testing	Support	Lead	Witness
20	Manufacturer's Certificate of Installation and Functionality Compliance	No Action	Lead	Witness, Review
Clean Water Facility Testing				
21	Test Water Management Plan Finalization	Support	Lead	Review
22	Clean Water Facility Testing	Witness	Lead	Witness, Review
Process Start-Up Phase				
Process Start-Up				
23	Commissioning Documentation and Data Review	Review	Support	Lead
24	Start-Up Go/No-Go Decision Criteria	Lead	Support	Review
25	Building and Fire Inspection Compliance Check	No Action	Lead	Witness
26	HVAC Functionality Check	No Action	Lead	Witness

NO.	TASK	OWNER	CONTRACTOR	ENGINEER
Testing and Training Phase				
27	Start-Up Sequence Review	Support	Lead	Review
28	Temporary Testing Arrangement Finalization	Support	Lead	Support
29	Start-Up Forms Finalization	Support	Lead	Support
30	Operation Testing Plan Finalization	Review	Support	Lead
31	Test Water Management Plan Finalization	Support	Lead	Review
32	System Testing	Support	Lead	Witness
33	Control Loop Tuning	Support	Lead	Witness
34	Process Area Start-Ups	Support	Lead	Witness
35	Facility-Wide Start-Up	Support	Lead	Witness
36	Process Control Systems Testing	Support	Lead	Witness
Process Operational Period				
39	Operational Testing	Support	Lead	Witness, Review
40	Final Testing Reports	Support	Lead	Review
41	Water Quality Testing and Documentation	Support	Lead	Review
<p>Legend:</p> <p>Lead: Primarily responsible for organization, coordination, and execution of task work product or result.</p> <p>Support: Assist the lead with organization, coordination, and execution of task work product or result.</p> <p>Witness: Observe and document completion of task work product or result.</p> <p>Review: As necessary to accept task work product result.</p> <p>No Action: Limited or no involvement.</p>				

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SECTION 01_75_18

DISINFECTION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Cleaning and disinfection requirements for new and existing facilities affected by the Work.

1.02 REFERENCES

- A. American Water Works Association (AWWA):
 1. C651 - Disinfecting Water Mains.
 2. C652 - Disinfection of Water Storage Facilities.
 3. C653 - Disinfection of Water Treatment Plants.
- B. U.S. Environmental Protection Agency (EPA):
 1. Safe Drinking Water Act (SDWA).

1.03 SUBMITTALS

- A. Submit disinfection test plan which details procedure to be utilized to disinfect the facilities including:
 1. Method and locations of disinfectant application.
 2. Locations of sampling points.
 3. Method of flushing and location of flushing ports (as appropriate for method of chlorination).
 4. Method of dechlorination (as appropriate for method of chlorination).
 5. Disposal location for chlorinated water (as appropriate for method of chlorination).
- B. Submit disinfection reports and include the following:
 1. Date issued.
 2. Project name and location.
 3. Treatment subcontractor's name, address, and phone number.
 4. Type and form of disinfectant used.
 5. Time and date of disinfectant injection start.
 6. Time and date of disinfectant injection completion.
 7. Test locations.
 8. Initial and 24-hour disinfectant residuals in milligrams per liter for each outlet tested.
 9. Time and date of flushing start.
 10. Time and date of flushing completion.
 11. Disinfectant residual after flushing in milligrams per liter for each outlet tested.
- C. Submit bacteriological reports and include the following:
 1. Date issued.
 2. Project name and location.
 3. Laboratory's name, certification number, address, and phone number.

4. Time and date of water sample collection.
5. Name of person collecting samples.
6. Test locations.
7. Time and date of laboratory test start.
8. Coliform bacteria test results for each outlet tested.
9. Certification that water conforms or fails to conform to bacterial standards of SDWA.
10. Bacteriologist's signature and bacteriological laboratory's evidence of certification.

D. Submit required permits, including but not limited to permit clearance:

1. Coordinate with Owner and Engineer to obtain any necessary signatures.

1.04 QUALITY ASSURANCE

- A. Bacteriological and physical chemistry laboratory: Certified by state in which Project is located.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Protect chlorine and bacteriological samples against damage and contamination.
- B. Maintain caution labels on hazardous materials.
- C. Maintain storage room dry and with temperatures as uniform as possible between 60 degrees Fahrenheit and 80 degrees Fahrenheit.

1.06 PROTECTION

- A. Provide necessary signs, barricades, and notices to prevent persons from accidentally consuming water or disturbing system being treated.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Disinfectant: Free chlorine in liquid, powder, tablet, or gas form in accordance with AWWA C653.
- B. Dechlorination agent: Sulfur dioxide, sodium bisulfate, sodium sulfite, or sodium thiosulfate in accordance with AWWA C653.

PART 3 EXECUTION

3.01 PRELIMINARY CLEANING

- A. Complete hydrostatic/leakage tests prior to disinfection.

- B. Clean newly constructed and/or modified facilities, in accordance with AWWA C653 and the following:
 - 1. Remove debris and material not associated with the structure or process prior to disinfection.
 - 2. Clean wall, floor, ceiling, and attached surfaces by use of high-pressure water jet, sweeping, scrubbing, or equally effective means.
 - 3. Remove water, paint flakes, sediment, dirt, and foreign material accumulated during cleaning.
 - 4. Remove by flushing or other means, soil and debris from water pipes and channels in accordance with AWWA C651.
 - 5. Protect surfaces from adverse environmental exposure between the preliminary cleaning and the disinfection stages.
- C. Prior to chlorination, clean newly constructed and/or modified facilities to be disinfected in accordance with AWWA C651, C652, or C653, as applicable.
- D. Contractor shall provide necessary blind flanges, hoses, sample taps, or any other appurtenances that may be required to clean and disinfect the piping and wetted surfaces.

3.02 SURFACES TO BE DISINFECTED

- A. Disinfect water storage reservoirs.
- B. Piping systems that are used to convey water, solutions, or chemicals to potable water facilities.

3.03 DISINFECTION OF WATER LINES

- A. Cleaning:
 - 1. Remove by flushing or other means, soil and debris from the water tanks in accordance with AWWA C652 prior to chlorination.
- B. Inspection:
 - 1. Verify that water system is completed and cleaned of soil and debris prior to chlorination.
 - 2. Start disinfection when conditions are satisfactory.
- C. System treatment:
 - 1. Perform disinfection of water lines and structures in accordance with AWWA C651, C652, and C653, and as specified in this Section.
 - 2. Starting at outlet closest to water source, bleed water from each outlet until water produces odor of disinfectant. Repeat process at each outlet throughout system.
 - 3. Test for disinfectant residual at each of following locations and other locations in accordance with submitted disinfection test plan:
 - a. Ends of piping runs.
 - b. Remote outlets.
 - c. Tanks.
 - d. Drain lines.
 - 4. Maintain disinfectant in system for appropriate 6-hour or 24-hour interval in accordance with AWWA C652.

5. When disinfectant residual is less than 10 milligrams per liter after 24 hours, repeat system treatment.

3.04 REPAIRS OR CONNECTIONS TO EXISTING LINES

- A. Clean and sterilize the interior surfaces of new piping, fittings, equipment, and appurtenances to be installed in an existing potable water system or connected to an existing system.
- B. Clean and sterilize the existing pipe or facilities for a minimum distance of 3 pipe diameters back from the ends of the pipe. Plug the ends of the line when work is not being performed on the pipe.
- C. Perform sterilization by swabbing each item with a concentrated chlorine solution:
 1. Each piece is to be disinfected prior to being assembled for installation in the existing pipe.
 2. Disinfect each piece just prior to assembly to help prevent recontamination.
 3. Plug the ends of the assembly until a new item is to be added to the assembly.
 4. Store disinfected materials on blocks to prevent contact with the ground.

3.05 FLUSHING

- A. Remove disinfection water from the facilities as appropriate for the type of disinfectant and method used for disinfection.
- B. Flush facilities with potable water containing no more disinfectant residual than the active distribution system or 1.0 milligrams per liter, whichever is greater (as appropriate for method of chlorination).
- C. Continue flushing until water at designated flushing ports contains disinfectant residual equal to concentration specified above.

3.06 DISPOSAL OF CHLORINATED WATER

- A. Dispose of chlorinated water in accordance with the submitted disinfection test plan and applicable requirements of federal, state, county, and city having jurisdiction over disposal of hazardous wastes in location of the Project and disposal site.
- B. Chlorinated water may only be disposed of in a sanitary sewer system Refer to Section 01_14_00 - Work Restrictions for flow rate requirements.

3.07 BACTERIOLOGICAL TEST

- A. Instruct bacteriological laboratory to collect water samples no sooner than 24 hours after start of disinfection of each facility.
- B. A minimum of 24 hours after flushing system and within 24 hours before the water main is placed in service, collect bacteriological quality samples at each of following locations and other locations in accordance with the submitted disinfection test plan and Standard Methods for the Examination of Water and Wastewater:
 1. Where water enters system.
 2. Ends of piping runs.
 3. Drain lines.

4. Remote outlets.
 5. Tanks.
- C. Analyze water samples in accordance with Standard Methods for Examination of Water and Wastewater.
- D. When bacteriological test proves water quality to be unacceptable, repeat disinfection treatment process until water meets quality standards for disinfection.

END OF SECTION

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SECTION 01_77_00
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Contract closeout requirements.
- B. This Section is supplementary to City of Mercer Island General Terms and Conditions.

1.02 REFERENCES

- A. American Water Works Association (AWWA).

1.03 FINAL CLEANING

- A. Perform final cleaning prior to inspections for Substantial Completion.
- B. Employ skilled workers who are experienced in cleaning operations.
- C. Use cleaning materials which are recommended by manufacturers of surfaces to be cleaned.
- D. Prevent scratching, discoloring, and otherwise damaging surfaces being cleaned.
- E. Broom clean exterior paved surfaces and rake clean other surfaces of site work:
 - 1. Police yards and grounds to keep clean.
- F. Remove dust, cobwebs, and traces of insects and dirt.
- G. Clean grease, mastic, adhesives, dust, dirt, stains, fingerprints, paint, blemishes, sealants, plaster, concrete, and other foreign materials from sight-exposed surfaces, and fixtures and equipment.
- H. Remove non-permanent protection and labels.
- I. Probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

1.04 WASTE DISPOSAL

- A. Arrange for and dispose of surplus materials, waste products, and debris off-site:
 - 1. Prior to making disposal on private property, obtain written permission from Owner of such property.
- B. Do not create unsightly or unsanitary nuisances during disposal operations.
- C. Maintain disposal site in safe condition and good appearance.

- D. Complete leveling and cleanup prior to Final Completion of the Work.

1.05 TOUCH-UP AND REPAIR

- A. Touch-up or repair finished surfaces on structures, equipment, fixtures, and installations that have been damaged prior to inspection for Substantial Completion.
- B. Refinish or replace entire surfaces which cannot be touched-up or repaired satisfactorily.

1.06 FINAL CLEANING AND DISINFECTION OF FACILITIES

- A. Shall be performed in accordance with 01_75_18 Disinfection.

1.07 SPARE PARTS

- A. Owner may request advanced delivery of spare parts, maintenance products, and special tools:
 - 1. Deduct the delivered items from the inventory list and provide transmittal documentation.
- B. Prior to Substantial Completion, arrange to deliver spare parts, maintenance products, and special tools to Owner at a location on site chosen by the Owner:
 - 1. Provide itemized list of spare parts and special tools that matches the identification tag attached to each item.
 - 2. Owner and Engineer will review the inventory and the itemized list to confirm it is complete and in good condition prior to signing for acceptance.

1.08 CLOSEOUT DOCUMENTS

- A. Submit following Closeout Submittals before Substantial Completion:
 - 1. Punch list of items to be completed or corrected with the request for issuance of Substantial Completion.
 - 2. Evidence of Compliance with Requirements of Governing Authorities.
 - 3. Project Record Documents.
 - 4. Approved Operation and Maintenance Manuals.
 - 5. Approved Warranties and Bonds.
 - 6. Keys and Keying Schedule.
 - 7. Completed contract requirements for commissioning and process start-up.
- B. Submit following Closeout Submittals before final completion of the Work and at least 7 days prior to submitting Application for Final Payment:
 - 1. Punch list of items have been completed and Engineer and Owner are satisfied that all deficiencies are corrected.
 - 2. Evidence of Payment and Release of Liens or Stop Payment Notices as outlined in Conditions of the Contract.
 - 3. Release of claims as outlined in Conditions of the Contract.
 - 4. Submit certification of insurance for products and completed operations, as specified in the General Conditions.
 - 5. Final statement of accounting.
 - 6. Submit Final (As-Built) Schedule as specified in Section 01_32_21 - Schedules and Reports.

1.09 PROJECT RECORD DOCUMENTS

A. As indicated in the General Terms and Conditions.

1.10 MAINTENANCE SERVICE

A. Maintenance service as specified in technical specifications.

1.11 SUBSTANTIAL COMPLETION

A. As indicated in the General Terms and Conditions.

1.12 FINAL COMPLETION

A. As indicated in the General Terms and Conditions.

1.13 FINAL ADJUSTMENT OF ACCOUNTS

A. As indicated in the General Terms and Conditions.

1.14 FINAL APPLICATION FOR PAYMENT

A. As indicated in the General Terms and Conditions.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01_78_24

OPERATION AND MAINTENANCE MANUALS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Preparation and submittal of Operation and Maintenance Manuals.

1.02 GENERAL

- A. Submit Operation and Maintenance Manuals as specified in technical sections.
- B. Make approved manuals available at project site for use by construction personnel and Owner.

1.03 SUBMITTALS

- A. Draft Operation and Maintenance Manuals:
 - 1. Submit prior to shipment of equipment or system to site.
 - 2. Shipment will be considered incomplete without the draft Operation and Maintenance Manuals.
 - 3. Quantity:
 - a. Hard copy: 3 sets.
 - b. Electronic: 2 USB flash drive.
- B. Final Operation and Maintenance Manuals:
 - 1. Make additions and revisions in accordance with Owner's and Engineer's review comments on draft manuals.
 - 2. Submit approved Operation and Maintenance Manuals at least 30 days prior to Functional Testing and at least 60 days prior to Owner Training.
 - 3. Quantity:
 - a. Hard copy: 3 sets.
 - b. Electronic: 2 USB flash drive.

1.04 PREPARATION

- A. General requirements:
 - 1. Provide dimensions in English units.
 - 2. Assemble material, where possible, in the same order within each volume.
 - 3. Reduce drawings and diagrams to 8 1/2 by 11-inch size, if possible unless otherwise specified.
 - 4. Complete forms on computer, handwriting not acceptable.
 - 5. Delete items or options not provided in the supplied equipment or system.
 - 6. Provide package control system annotated ladder logic for PLC, if applicable.
- B. Hard copy requirements:
 - 1. Binders: 3-ring with rigid covers:
 - a. Break into separate binders as needed to accommodate large size.

2. Utilize numbered tab sheets to organize information.
3. Provide original and clear text on reproducible non-colored paper, 8 1/2 by 11-inch size, 24 pound paper.
4. Drawings larger than 8 1/2 by 11 inch:
 - a. Fold drawings separately and place in envelope bound into the manual.
 - b. Label each drawing envelope on the outside regarding contents.

C. Electronic requirements:

1. File format:
 - a. Entire manual in PDF format:
 - 1) Include text and drawing information.
 - 2) Provide a single PDF file even if the hard copy version is broken into separate binders due to being large.
 - 3) Create PDF from the native format of the document (Microsoft Word, graphics programs, drawing programs, etc.):
 - a) If material is not available in native format and only available in paper format, remove smudges, fingerprints, and other extraneous marks before scanning to PDF format.
 - b) Hard copy record drawing requirements:
 - (1) Provide a single multipage PDF file of each set of the scanned drawings.
 - (2) Page 1 shall be the cover of the drawing set.
 - c) At file opening, display the entire cover:
 - (1) Scan drawings at 200 to 300 dots per inch (DPI), black and white, Group IV Compression, unless otherwise specified.
 - (2) Scan drawings with photos in the background at 400 dots per inch (DPI), black and white, Group IV Compression.
 - 4) Pagination and appearance to match hard copy.
 - 5) Searchable.
 - 6) Scanned images are not acceptable.
 - 7) Bookmarks:
 - a) Bookmarks shall match the table of contents.
 - b) Bookmark each section (tab) and heading.
 - c) Drawings: Bookmark at a minimum, each discipline, area designation, or appropriate division.
 - d) At file opening, display all levels of bookmarks as expanded.
 - 8) Thumbnails optimized for fast web viewing.
 - b. Drawing requirements:
 - 1) Provide additional copy of drawings in most current version of AutoCAD format.
 - 2) Drawings shall have a white background.
 - 3) Drawing shapes shall not degrade when closely zoomed.
 - 4) Screening effects intended to de-emphasize detail in a drawing must be preserved.
 - 5) Delete items or options not provided in the supplied equipment or system.
2. Media:
 - a. USB flash drive.
 - b. Secure File Transfer Protocol (SFTP).
3. Label media with the following information:
 - a. Operation and Maintenance Manual.
 - b. Equipment name.

- c. Specification Section Number.
 - d. Equipment tag number.
 - e. Owner's name.
 - f. Project number and name.
 - g. Date.
4. If multiple submittals are made together, each submittal must have its own subdirectory that is named and numbered based on the submittal number.

1.05 CONTENTS

- A. Label the spines:
 1. Equipment name.
 2. Tag number.
 3. Project name.
 4. Owner name.
- B. Cover page:
 1. Operation and Maintenance Manual.
 2. Equipment name.
 3. Specification Section Number.
 4. Equipment tag number.
 5. Owner's name.
 6. Project number and name.
 7. Date.
- C. Table of Contents: General description of information provided within each tab section.
- D. Equipment Summary Form: Completed form as specified in Appendix A of this Section.
- E. Electric Motor Technical Data Form: Completed form as specified in Appendix C of this Section.
- F. Description of system and components.
- G. Description of equipment function, normal operating characteristics, and limiting conditions.
- H. Manufacturer's product data sheets:
 1. Where printed material covers more than 1 specific model, indicate the model number, calibrated range, and other special features.
- I. Assembly, installation, alignment, adjustment, and checking instructions.
- J. Storage instructions.
- K. Control diagrams:
 1. Internal and connection wiring, including logic diagrams, wiring diagrams for control panels, ladder logic for computer based systems, and connections between existing systems and new additions, and adjustments such as calibrations and set points for relays, and control or alarm contact settings.
 2. Complete set of 11-inch by 17-inch drawings of the control system.

3. Complete set of control schematics.
- L. Programming: Copies of Contractor furnished programming.
- M. Start-up procedures: Recommendations for installation, adjustment, calibration, and troubleshooting.
- N. Operating procedures:
1. Step-by-step instructions including but not limited to the following:
 - a. Safety precautions and applicable Safety Data Sheets.
 - b. Guidelines.
 - c. Manual keyboard entries.
 - d. Entry codes.
 - e. System responses.
 - f. Other information as needed for safe system operation and maintenance.
 2. Modes:
 - a. Startup.
 - b. Routine and normal operation.
 - c. Regulation and control.
 - d. Shutdown under specified modes of operation.
 - e. Emergency operating shutdown.
- O. Preventative maintenance procedures:
1. Recommended steps and schedules for maintaining equipment.
 2. Troubleshooting.
- P. Lubrication information: Required lubricants and lubrication schedules.
- Q. Overhaul instructions: Directions for disassembly, inspection, repair and reassembly of the equipment; safety precautions; and recommended tolerances, critical bolt torques, and special tools that are required.
- R. Parts list:
1. Complete parts list for equipment including but not limited to the following information.
 2. Catalog data: Generic title and identification number of each component part of equipment.
 3. Include bearing manufacturer, model and ball or roller pass frequencies for every bearing.
 4. Availability.
 5. Service locations.
- S. Spare parts list: Recommended number of parts to be stored at the site and special storage precautions.
- T. Engineering data:
1. Drawings: Complete set of 11-inch by 17-inch equipment drawings.
 2. Exploded view or plan and section views with detailed callouts.
 3. Outline, cross-section, and assembly drawings.
 4. System drawings: Provide interconnection and wiring diagrams, plan views, panel layouts, bill of materials, etc.

5. Packaged equipment system drawings: Provide instrumentation loop drawing, control schematic diagrams, interconnection and wiring diagrams, plan views, panel layouts, bill of materials, etc.
 6. System drawings and data sheets: Include drawings and data furnished by the Engineer and the Supplier; provide "as installed" version.
 7. Provide electrical and instrumentation schematic record drawings.
- U. Test data and performance curves, when applicable.
- V. Manufacturer's technical reference manuals.
- W. Source (factory) Test results: Provide copies of Source Tests reports as specified in technical sections.
- X. Functional Test results: After Functional Tests are completed, insert Functional Test reports as specified in technical sections.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

**APPENDIX A
EQUIPMENT SUMMARY FORM**

1. EQUIPMENT ITEM _____
2. MANUFACTURER _____
3. EQUIPMENT IDENTIFICATION NUMBER(S) _____
(maps equipment number)
4. LOCATION OF EQUIPMENT _____
5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) _____

NAMEPLATE DATA -

Horsepower _____
 Amperage _____
 Voltage _____
 Service Factor (S.F.) _____
 Speed _____
 ENC Type _____
 Capacity _____
 Other _____

7. MANUFACTURER'S LOCAL REPRESENTATIVE

Name _____
 Address _____
 Telephone Number _____

8. MAINTENANCE REQUIREMENTS:

Maintenance Operation	Frequency	Lubricant (if applicable)	Comments
(List each operation required. Refer to specific information in Manufacturer's Manual, if applicable)	(List required frequency of each maintenance operation)	(Refer by symbol to lubricant list as required)	

9. LUBRICANT LIST:

Reference Symbol	Conoco Phillips	Exxon/Mobil	BP/Amoco	Other (List)
(Symbols used in Item 7 above)	(List equivalent lubricants, as distributed by each manufacturer for the specific use recommended)			

10. SPARE PARTS (recommendations) _____

11. COMMENTS _____

12. GENERAL INFORMATION:

Date Accepted*: _____

Expected Life*: _____

Project Name & Number: _____

Design Engineer: _____

13. WARRANTY:

Start Date: _____

Expiration Date: _____

Prorated: _____

**APPENDIX B
ELECTRIC MOTOR TECHNICAL DATA**

Technical Data for Each Motor:

Application: _____

Manufacturer: _____

Frame No.: _____ Type: _____

Code Letter: _____ Design Letter: _____

Rating:

Horsepower: _____ Voltage: _____ Phase: _____

Cycles: _____ Full Load rpm: _____
(wound rotor secondary)

Volts: _____ Amperes: _____

Full Load Current: _____ amperes

Locked Rotor Current: _____ amperes

Locked Rotor or Starting Torque (percent of full load): _____ percent

Full Load Torque: _____ ft-lb

Breakdown Torque: _____ percent

Efficiency:

Full Load: _____ percent

3/4 Load: _____ percent

1/2 Load: _____ percent

Power Factor:

Full Load _____ percent

3/4 Load: _____ percent

1/2 Load: _____ percent

Insulation:

Type: _____

Class: _____

Temperature Rise: _____ Above Ambient: _____

Enclosure: _____

Net Weight: _____ lbs

Wk²: _____ lbs/sq ft

Type of Bearings: _____

Service Factor: _____

Noise Level in Decibels: _____

Heaters: _____ kW, _____ Phase, _____ volts

Altitude: _____

SECTION 01_78_36

WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Warranty and bonds requirements.
- B. This section is supplemental to the General Terms and Conditions.

1.02 SUBMITTALS

- A. For each item of material or equipment furnished under the Contract:
 - 1. Submit manufacturer's warranty prior to fabrication and shipment of the item from the manufacturer's facility.
 - 2. Submit manufacturer's special warranty when specified.
- B. Provide consolidated warranties and bonds within 15 calendar days of Substantial Completion:
 - 1. Contents:
 - a. Organize warranty and bond documents:
 - 1) Include Table of Contents organized by specification section number and the name of the product or work item.
 - b. Include each required warranty and bond in proper form, with full information, are certified manufacturer as required, and are properly executed by Contractor, or subcontractor, supplier, or manufacturer.
 - c. Provide name, address, phone number, and point of contact of manufacturer, supplier, and installer, as applicable.
 - 2. Electronic copy in PDF format:
 - a. Submit 1 copy.

1.03 OWNER'S RIGHTS

- A. Owner reserves the right to reject warranties.
- B. Owner reserves the right to refuse to accept Work for the project if the required warranties have not been provided.

1.04 RELATIONSHIP TO GENERAL WARRANTY AND CORRECTION PERIOD

- A. Warranties specified for materials and equipment shall be in addition to, and run concurrent with, both Contractor's general warranty and the correction period requirements.
- B. Disclaimers and limitations in specific materials and equipment warranties do not limit Contractor's general warranty, nor does such affect or limit Contractor's performance obligations under the correction period.

1.05 MANUFACTURER'S WARRANTY MINIMUM REQUIREMENTS

- A. Written warranty issued by item's manufacturer.
- B. Project-specific information, properly executed by product manufacturer, and expressly states that its provisions are for the benefit of the Owner.
- C. Covers all costs associated with the correction of the defect, including but not limited to removal of defective parts, new parts, labor, and shipping:
 - 1. When correcting warranted Work that has failed, remove and replace other Work that had been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- D. Provides a timely response to correct the defect:
 - 1. Manufacturer shall provide, in a timely fashion, temporary equipment as necessary to replace warranted items requiring repair or replacement, when warranted items are in use and are critical to the treatment process, as defined by Owner.
 - 2. In the case that Owner has to provide temporary equipment to replace function of warranted item requiring repair or replacement, manufacturer shall reimburse Owner for such costs associated with the temporary equipment.
- E. Warranty commence running on the date of substantial completion:
 - 1. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit warranty within 10 calendar days after acceptance, listing date of acceptance as beginning of warranty period.
- F. Duration of Warranty: 1 year.

1.06 MANUFACTURER'S SPECIAL WARRANTY

- A. Manufacturer's special warranty is a written warranty published by the manufacturer which includes the requirements specified in the section where the item is specified:
 - 1. Includes Project-specific information and requirements, properly executed by product manufacturer, and expressly states that its provisions are for the benefit of the Owner. Technical sections indicate Project-specific requirements that differ from the minimum warranty requirements for that item:
 - a. Examples include extending the duration of manufacturer's warranty or to provide increased rights to Owner.

1.07 WARRANTY WORK

- A. Contractor's responsibilities:
 - 1. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the product, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with Contractor.

- B. Replacement cost:
 - 1. Upon determination that work covered by warranty has failed, replace or rebuild the work to an acceptable condition complying with requirement of the Contract Documents:
 - a. Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether Owner has benefited from the use of the work through a portion of its anticipated useful service life.
- C. Related damages and losses:
 - 1. When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.
- D. Owner's recourse:
 - 1. Written warranties are in addition to implied warranties, and shall not limit the duties, obligations, rights, and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitation on time in which Owner can enforce such other duties, obligations, rights, or remedies.
- E. Reinstatement of warranty:
 - 1. When work covered by a warranty has failed and has been corrected by replacement or rebuilding, reinstate the warranty by written endorsement:
 - a. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

1.08 IMPLIED WARRANTIES

- A. Warranty of title and intellectual rights:
 - 1. Except as may be otherwise indicated in the Contract Documents, implied warranty of title required by Laws and Regulations is applicable to the Work and to materials and equipment incorporated therein.
 - 2. Provisions on intellectual rights, including patent fees and royalties, are in the General Conditions, as may be modified by the Supplementary Conditions.
- B. Implied warranties: Duration in accordance with Laws and Regulations.

1.09 BONDS

- A. Equipment bond and other bond requirements as specified in the technical sections.
- B. Bonds commence running on the date of substantial completion:
 - 1. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit warranty within 10 calendar days after acceptance, listing date of acceptance as beginning of bond period.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01_81_01

PROJECT DESIGN CRITERIA

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Project design criteria such as temperature and site elevation.

1.02 PROJECT DESIGN CRITERIA

- A. Equipment and materials for the project are to be suitable for performance in domestic water facility environment and under following conditions:
 - 1. Design temperatures are:
 - a. Outdoor temperatures: -7 to 40 degrees Celsius.
 - b. Indoor temperatures: -7 to 40 degrees Celsius.
 - 2. Design groundwater elevation: 3 feet below grade.
 - 3. Freeze-thaw conditions.
 - 4. Moisture conditions: Defined in individual equipment sections.
 - 5. Site elevation: Approximately 370 feet above mean sea level.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01_81_02

SEISMIC DESIGN CRITERIA

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Seismic design criteria for the following:
1. Anchorage of mechanical and electrical equipment and tanks.
 2. Other structures or items as specified or indicated on the Drawings.

1.02 REFERENCES

- A. American Society of Civil Engineers (ASCE):
1. 7-16 - Minimum Design Loads for Buildings and Other Structures.

1.03 SYSTEM DESCRIPTION

- A. Design in accordance with the requirements of the building code as specified in Section 01_41_00 - Regulatory Requirements.

- B. Risk Category:

Table 1: Risk Category	
Structure/Area	Risk Category
All Structures and Distribution Pumping Equipment	IV
Booster Chlorination System Equipment	III

- C. Design spectral acceleration at short period, S_{DS} : 1.137.
- D. Design of non-structural components and their connections to structures:
1. Component amplification factor, a_p : In accordance with ASCE 7, Tables 13.5-1 and 13.6-1.
 2. Component response modification factor, R_p : In accordance with ASCE 7, Tables 13.5-1 and 13.6-1.
 3. Component importance factor, $I_p = 1.50$ for all equipment.
- E. Seismic Design Category (SDC) is D for all areas.
- F. Design requirements: Anchorage of equipment and tanks to structures:
1. Do not use friction to resist sliding due to seismic forces. Do not design or provide connections that use friction to resist seismic loads. Resist seismic

- forces through direct tension and/or direct bearing in shear on anchors and fasteners.
2. Do not use more than 60 percent of the weight of the mechanical and electrical equipment for designing anchors for resisting overturning due to seismic forces.
 3. Do not use more than 60 percent of the weight of the tank for resisting overturning due to seismic forces.
 4. Anchoring and fastening to concrete:
 - a. Anchors provided under the following Specifications shall hold a current Evaluation Service report allowing use in Seismic Design Categories indicated for this Work:
 - 1) Post-installed adhesive bonded anchors specified in Section 03_21_17 - Adhesive-Bonded Reinforcing Bars and All Thread Rods in Concrete.
 5. Anchor bolt holes in tanks or equipment support frames:
 - a. Do not exceed bolt diameter by more than 25 percent, up to a maximum diameter equal to that of the bolt plus 1/4 inch.

1.04 SUBMITTALS

- A. Shop drawings and calculations: Complete shop drawings and seismic calculations for anchorage to structures.
- B. Calculations shall be signed and sealed by a professional engineer licensed in the State of Washington.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 03_01_04

STRUCTURAL CONCRETE REPAIR

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Repairing damaged concrete or concrete surfaces after demolition.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. A301 – Specifications for Concrete Construction.
- B. ASTM International (ASTM):
 - 1. C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens).
 - 2. C293 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading).
 - 3. C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars).
 - 4. C666 - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
 - 5. C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.

1.03 SUBMITTALS

- A. Product data: Submit manufacturer's data completely describing structural repair concrete materials.
- B. Manufacturer's Instructions.

1.04 QUALITY ASSURANCE

- A. Manufacturer qualifications: The manufacturer of the specified product shall have been in existence, for a minimum of 10 years.
- B. Allowable tolerances: Deviation from plumb or level shall not exceed 1/8 inch within 10 feet in any direction, as determined with a 10-foot straight edge.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle packaged materials in the manufacturer's original, sealed containers, each clearly identified with the manufacturer's name, and name and type of product.
- B. Store materials subject to damage by dirt and moisture in a clean, dry location, off the ground, and suitably protected.

1.06 PROJECT CONDITIONS

- A. Existing conditions:
 - 1. Do not place concrete repair mortar during precipitation unless adequate protection is provided.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

- A. General: Structural repair concrete composed of cementitious material capable of being placed in formed vertical and overhead applications, and on horizontal surfaces.
- B. Design requirements:
 - 1. Provide material suitable for performing in environments subject to corrosive attack by chlorides and sulfates, freeze/thaw cycles, low permeability, and abrasion resistant.
 - 2. Provide concrete repair mortar cement that is placeable from 1 inch in depth and extendable in greater depths.
 - 3. Concrete repair mortar shall be capable of being poured in place or troweled in place to suit the conditions encountered.

2.02 MATERIALS

- A. Structural repair concrete:
 - 1. Manufacturers: One of the following or equal:
 - a. BASF, MasterEMACO S66-CI.
 - b. Sika Corp., SikaTop 123 Plus.
 - 2. Compressive strength: As follows in accordance with ASTM C109:
 - a. 1 day: 2,500 pounds per square inch, minimum.
 - b. 7 day: 6,000 pounds per square inch, minimum.
 - c. 28 day: 7,000 pounds per square inch, minimum.
 - 3. Bond strength by slant shear: 2,200 pounds per square inch minimum at 28 days, in accordance with ASTM C882 modified.
 - 4. Flexural strength: 2,000 pounds per square inch minimum at 28 days, when tested in accordance with ASTM C293, or 770 pounds per square inch minimum at 28 days when tested in accordance with ASTM C348.
 - 5. Rapid freeze/thaw durability: In accordance with ASTM C666; Procedure A:
 - a. Relative durability factor at 300 cycles: 95 percent minimum.
 - 6. Working time: 30 to 40 minutes.
 - 7. Color: Concrete gray.
- B. Water: Potable, clean, not detrimental to concrete.
- C. Form materials:
 - 1. As-cast finish: In accordance with the requirements of ACI 301, Section 5.3.3.2 and Section 5.3.2(B) Surface Finish SF-2.
 - 2. Brace as required to maintain tolerances.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that concrete surfaces and exposed reinforcing are clean and free of contaminants.

3.02 PREPARATION

- A. Prepare existing concrete by cleaning and roughening and applying bonding agent in accordance with manufacturer's instructions.
- B. Thoroughly clean reinforcement and other embedded items to remove loose rust and other objectionable matter.
- C. Thoroughly wet wood forms, except coated plywood, and adjacent concrete at least 1 hour in advance of placing concrete; securely close cleanout end inspection ports; repeat wetting as necessary to keep forms damp.
- D. Damaged concrete:
 - 1. Areas to be repaired shall be clean, sound, and free of contaminants:
 - a. Remove loose and deteriorated concrete by mechanical means acceptable to the Engineer.
 - b. Saw cut perimeter 1/2-inch maximum.
 - 2. Chip concrete substrate to obtain a surface profile of 1/16 inch to 1/8 inch in depth with a new fractured aggregate surface:
 - a. The area to be repaired shall be not less than 1 inch in depth.
 - 3. Concrete removal shall extend along the reinforcing steel to locations along the bar free of bond inhibiting corrosion, and where the bar is well bonded to surrounding concrete.
- E. Use the following procedures where reinforcing steel with active corrosion is encountered:
 - 1. Sandblast reinforcing steel to remove contaminants and rust.
 - 2. Determine section loss, splice new reinforcing steel where there is more than 15 percent loss as directed by the Engineer:
 - a. If more than half the diameter of the reinforcing steel is exposed, chip out behind the reinforcing steel a minimum of 1/2 inch. The distance chipped behind the reinforcing steel must also equal or exceed the minimum placement depth of the accepted material.
- F. Treat cracks in the substrate at the area of patching or overlay work as directed by the Engineer.
- G. Extend existing control and expansion joints through any concrete repair.
- H. Apply an epoxy-bonding agent to area to be repaired, as specified in Section 03_63_01 - Epoxies prior to patching concrete with polymer-modified portland cement mortar.

3.03 MIXING

- A. Mix in accordance with manufacturer's mixing instructions.

3.04 INSTALLATION

- A. Formed surface finishes:
 - 1. Smooth finish:
 - a. Obtain by the use of plywood, sheet metal, or lined wood forms; no fins, pockmarks, or other irregularities shall be present in the exposed surfaces of concrete.
 - b. Place no structural repair concrete without prior authorization of Engineer.
- B. Verify that form materials are in place and ready to receive installation of concrete repair material.
- C. Install in accordance with manufacturer's installation instructions.
- D. In accordance with ACI recommendations, apply concrete repair material only when ambient conditions of moisture, temperature, humidity, and wind are favorable for curing.
- E. Scrub mortar into substrate, filling cracks, voids, and pores.
- F. For new construction, finish of repaired area shall match required finish for concrete being repaired.
- G. For existing concrete, finish of repair area shall match finish of concrete being repaired.
- H. During the curing process, protect concrete repair from rain, wind, or freezing as required:
 - 1. Keep sufficient covering on hand at all times for protection of repair concrete.

3.05 CLEANING

- A. Remove debris and excess material. Leave work site in a neat, clean condition.

END OF SECTION

SECTION 03_21_17

ADHESIVE-BONDED REINFORCING BARS AND ALL THREAD RODS IN CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Bonding reinforcing bars and all thread rods in concrete using adhesives.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 355.4 - Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary.
- B. American National Standards Institute (ANSI):
 - 1. Standard B212.15 - Carbide Tipped Masonry Drills and Blanks for Carbide Tipped Masonry Drills.
- C. ASTM international (ASTM):
 - 1. C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- D. Concrete Reinforcing Steel Institute (CRSI).
- E. ICC Evaluation Service, Inc. (ICC-ES):
 - 1. AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
- F. Society for Protective Coatings (SSPC):
 - 1. SP-1 - Solvent Cleaning.

1.03 DEFINITIONS

- A. Evaluation Service Report (ESR): Report prepared by ICC-ES, or other testing agency acceptable to Engineer and to the Building Official, that documents testing and review of a product to confirm that it complies with the requirements of designated ICC-ES Acceptance Criteria, and to document its acceptance for use under the Building Code specified in Section 01_41_00 - Regulatory Requirements.

1.04 SUBMITTALS

- A. Product data: Technical data for adhesives, including:
 - 1. Manufacturer's printed installation instructions (MPII).
- B. Quality control submittals:
 - 1. Special inspection: Detailed step-by-step instructions for the special inspection procedures required by the building code specified in Section 01_41_00 - Regulatory Requirements.

2. For each adhesive to be used, Evaluation Report confirming that the product complies with the requirements of AC308 for both un-cracked and cracked concrete and for use in Seismic Design Categories A through F.
 3. Installer qualifications:
 - a. Submit evidence of successful completion of adhesive manufacturer's installation training program.
 - b. Submit evidence of current certification for installation of inclined and overhead anchors under sustained tension loading.
- C. Inspection and testing reports:
1. Inspections: Field quality control: Reports of inspections and tests.

1.05 QUALITY ASSURANCE

- A. Qualifications:
1. Installation requirements:
 - a. Have available at the site, and install anchors in accordance with, the adhesive manufacturer's printed installation instructions.
 2. Installer qualifications:
 - a. Demonstrating successful completion of adhesive manufacturer's on-site training program for installation of adhesive-bonded anchors.
 - b. Holding current certification for installation of adhesive-bonded anchors by a qualified organization acceptable to the Engineer and to the Building Official:
 - 1) Organizations/certification programs deemed to be qualified are:
 - a) ACI-CRSI Adhesive Anchor Installer Certification Program.
 - b) Adhesive anchor manufacturer's certification program, subject to acceptance by the Engineer and the Building Official.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect products as follows, unless more restrictive requirements are recommended by the manufacturer:
1. Store adhesives and adhesive components on pallets or shelving in a covered-storage area protected from weather.
 2. Dispose of products that have passed their expiration date.

1.07 PROJECT CONDITIONS

- A. As specified in Section 01_81_02 - Seismic Design Criteria.

PART 2 PRODUCTS

2.01 GENERAL

- A. Adhesives shall have a current Evaluation Report documenting testing and compliance with the requirements of ACI 355.4 and of ICC-ES AC308 for use with un-cracked concrete and with cracked concrete in the Seismic Design Category specified.

- B. Bond reinforcing bars and all thread rods in concrete using epoxy adhesive unless other adhesives specified are specifically indicated on the Drawings or approved in writing by the Engineer.

2.02 EPOXY ADHESIVE

- A. Materials:
 - 1. Meeting the physical requirements of ASTM C881, Type IV, Grade 3, Class B or C depending on site conditions.
 - 2. 2-component, 100 percent solids, insensitive to moisture.
 - 3. Cure temperature, pot life, and workability: Compatible with intended use and environmental conditions.
- B. Packaging:
 - 1. Disposable, self-contained cartridge system furnished in side-by-side cartridges designed to fit into a manually or pneumatically operated caulking gun, and with resin and hardener components isolated until mixing through manufacturer's static mixing nozzle:
 - a. Nozzle designed to dispense components in the proper ratio and to thoroughly blend the components for injection from the nozzle directly into prepared hole.
 - b. Provide nozzle extensions as required to allow full-depth insertion and filing from the bottom of the hole.
 - 2. Container markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
- C. Manufacturers: One of the following or equal:
 - 1. Hilti, Inc., HIT-RE 500-V3.
 - 2. Simpson Strong-Tie Co., Inc., SET-XP.

2.03 ALL THREAD RODS

- A. Materials: As specified in Section 05_12_00 - Structural Steel for rods, nuts and washers.

2.04 REINFORCING BARS

- A. As specified in Section 03_30_01 - Cast in Place Concrete.

PART 3 EXECUTION

3.01 GENERAL

- A. Execution of this work is restricted to installers who have completed the adhesive manufacturer's on-site training for the products to be installed, and who are certified through a qualified certification program described under Quality Assurance and accepted by the Engineer and the Building Official:
 - 1. Do not install holes or adhesive until training is complete.

- B. Perform work in strict compliance with the accepted MPII and the following instructions. Where the accepted MPII and the instructions conflict, the MPII shall prevail.
- C. Install reinforcing bars and all thread rods to embedment depth, and at spacing and locations indicated on the Drawings:
 - 1. If embedment depth is not indicated, contact Engineer for requirements.
 - 2. Do not install adhesive-bonded all thread rods or reinforcing bars in upwardly inclined or overhead applications unless accepted in advance by Engineer.

3.02 PREPARATION

- A. Do not begin installation of adhesive bonded anchors until:
 - 1. Concrete has achieved an age of at least 21 days after placement.
- B. Review manufacturer's printed installation instructions (MPII) and "conditions of use" stipulated in the Evaluation Report before beginning work.
- C. Install adhesive bonded anchors in full compliance with manufacturer's printed installation instructions using personnel who have successfully completed manufacturer's on-site training for products to be used and who hold certifications specified in this Section.
- D. Confirm that adhesive and substrate receiving adhesive are within manufacturer's recommended range for temperature and moisture conditions and will remain so during the curing time for the product.

3.03 HOLE SIZING AND INSTALLATION

- A. Drilling holes:
 - 1. Determine location of reinforcing bars or other obstructions with a nondestructive indicator device, and mark locations with construction crayon on the surface of the concrete.
 - 2. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without prior acceptance by Engineer.
- B. Hole diameter: As recommended in the manufacturer's installation instructions and the Evaluation Report.
- C. Hole depth: As recommended in the manufacturer's installation instructions to provide minimum effective embedment indicated on the Drawings.
- D. Obstructions in drill path:
 - 1. If an existing reinforcing bar or other obstruction is hit while drilling a hole, unless otherwise accepted by Engineer, stop drilling. Prepare and fill the hole with dry-pack mortar. Relocate the hole to miss the obstruction and drill another hole to the required depth:
 - a. Obtain Engineer's acceptance of distance between abandoned and relocated holes before proceeding with the relocation.
 - b. Allow dry-pack mortar to cure to a strength equal to that of the surrounding concrete before resuming drilling in the area.

- c. Epoxy grout may be substituted for dry-pack mortar when accepted by Engineer.
 2. When existing reinforcing steel is encountered during drilling and when specifically accepted by Engineer, enlarge the hole by 1/8 inch, core through the existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter using pneumatic rotary impact drill.
 3. Bent bar reinforcing bars: Where edge distances are critical, and interference with existing reinforcing steel is likely, if acceptable to Engineer, drill hole at 10 degree (or less) angle from axis of reinforcing bar or all thread rod being installed.
- E. Cleaning holes:
1. Clean and prepare holes as recommended by the epoxy manufacturer.

3.04 INSTALLATION OF ADHESIVE AND INSERTS

- A. Clean and prepare inserts reinforcing bars and all thread rods:
1. Prepare embedded length of reinforcing bars and all thread rods by cleaning to bare metal. Inserts shall be free of oil, grease, paint, dirt, mill scale, rust, or other coatings that will reduce bond.
 2. Solvent clean prepared reinforcing bars and all thread rods over the embedment length in accordance with SSPC SP-1. Provide an oil and grease free surface for bonding of adhesive to steel.
- B. Fill holes with adhesive:
1. Starting at the bottom of the hole, fill hole with adhesive inserting the reinforcing bar or all thread rod.
 2. Fill hole as nozzle is withdrawn without creating air voids.
 3. Unless otherwise indicated on the Drawings, fill hole with sufficient adhesive so that excess adhesive is extruded out of the hole when the reinforcing bar or all thread rod is inserted.
 4. Where necessary, seal hole at surface of concrete to prevent loss of adhesive during curing.
- C. Installing reinforcing bars and all thread rods:
1. Unless otherwise indicated on the Drawings, install bars and rods perpendicular to the concrete surface.
 2. Insert reinforcing bars and all thread rods into adhesive in accordance with manufacturer's recommended procedures.
 3. Confirm that insert has reached the designated embedment in the concrete, and that adhesive completely surrounds the embedded portion.
 4. Securely brace bars and all thread rods in place to prevent displacement while the adhesive cures. Bars and rods displaced during curing will be considered damaged and replacement will be required.
 5. Clean excess adhesive from the mouth of the hole.
- D. Curing and loading:
1. Provide and maintain curing conditions recommended by the adhesive manufacturer for the period required to fully cure the adhesive at the temperature of the concrete.
 2. Do not disturb or load bonded embeds until manufacturer's recommended cure time, based on temperature of the concrete, has elapsed.

3.05 POST-INSTALLATION ACTIVITIES

- A. Do not bend bars or all-thread rods after bonding to the concrete, unless accepted in advance by the Engineer.

3.06 FIELD QUALITY CONTROL

- A. Provide field quality control over the Work of this Section as specified in Section 01_45_00 - Quality Control.
- B. Field inspections and testing:
 - 1. Hole drilling and preparation.
 - 2. Results: Submit records of inspections and testing to Engineer by electronic copies within 24 hours after completion.

3.07 FIELD QUALITY ASSURANCE

- A. Provide field quality assurance over the Work of this Section as specified in Section 01_45_00 - Quality Control.

END OF SECTION

SECTION 03 30 01

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies cast-in-place reinforced concrete, including reinforcing, embedded material and formwork.

1.02 QUALITY CONTROL

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following document. It is a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

Reference	Title
IBC	International Building Code
ACI 301	Specifications for Structural Concrete
ACI 308.1	Specification for Curing Concrete
ACI 309R	Guide for Consolidation of Concrete
ACI 318	Building Code Requirements for Structural Concrete
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C685	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
ASTM E329	Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
CRSI	Manual of Standard Practice

- B. Testing
1. Perform materials testing to demonstrate conformance with the specifications.
 2. Provide quality control as specified in Section 01_45_00 - Quality Control.

- C. Be responsible for controlling the quality of the materials and work.
- D. Obtain services of an independent testing laboratory to perform required tests to document compliance with the Contract requirements.
- E. Perform work of this section in accordance with the Referenced Standards.
- F. Perform required repair and remediation to meet the requirements of the Contract Documents for all concrete that fails to meet the specified requirements.

1.03 SUBMITTALS

- A. Concrete-Mix Designs.
- B. Reinforcing Steel.
- C. Concrete Placement Drawings.
- D. Submit manufacturer's data on specified products showing compliance with requirements.
- E. Submit manufacturers' data on contractor selected products showing quality and suitability for the application. Contractor selected products are to be standards typically used in the industry for similar applications.

1.04 CONCRETE MIX DESIGNS

- A. Compressive Strengths: unless otherwise specified, provide the following as minimum:
 - 1. Concrete compressive strength at 28-days: 4000 psi.
 - 2. High Early Strength Concrete for Thrust Collars compressive strength at 3-days: 4000 psi.
 - 3. CDF compressive strength at 28-days: 300 minimum – 500 maximum psi.

PART 2 PRODUCTS

2.01 REINFORCEMENT

- A. Comply with the following as minimums:
 - 1. Bars - ASTM A615, grade 60, unless otherwise shown, using deformed bars for Number 3 and larger.
 - 2. Welded Wire Fabric - ASTM A1064.
 - 3. Bending - ACI 318.
- B. Fabricate reinforcement to the required shapes and dimensions, within fabrication tolerances stated in the Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice.
- C. Do not use reinforcement having any of the following defects:
 - 1. Bar lengths, depths, or bends exceeding the specified fabricating tolerances.
 - 2. Bends or kinks not indicated on the Drawings or required for this work.
 - 3. Bars with cross-section reduced due to excessive rust or other causes.

2.02 CONCRETE

- A. Minimum Requirements:
 - 1. Portland Cement: ASTM C150, Type I or II, low-alkali.
 - 2. Aggregate, General:
 - a. ASTM C33 uniformly graded and clean.
 - b. Do not use aggregate known to cause excessive shrinkage.
 - 3. Aggregate, Coarse: crushed rock or washed gravel with maximum size between 3/4-inch and 1-1/2 inches.
 - 4. Aggregate, Fine: natural washed sand of hard and durable particles varying from fine to particles passing a 3/8-inch screen, of which at least 12 percent shall pass a 50-mesh screen.
 - 5. Water: clean and potable.

2.03 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation as selected by the Contractor.
- B. Form Release Agent:
 - 1. Material: Release agent shall not bond with, stain, or adversely affect concrete surfaces, and shall not impair subsequent treatments of the concrete surfaces. A ready-to-use water based material formulated to reduce or eliminate surface imperfections, containing no mineral oil or organic solvents. Release agent shall be environmentally safe, and shall meet the requirements of the referenced standards.
 - 2. Acceptable Products:
 - a. BASF: MasterFinish RL 211.
 - b. Cresset Chemical Company: Crete-Lease 20-VOC or Crete-Lease 880-VOC.
 - c. US Mix Products Company: US SPEC Ezkote Green.
 - d. Approved Equal.
- C. Corners: Filleted, rigid plastic type; 3/4 x 3/4 inch size; maximum possible lengths.

PART 3 EXECUTION

3.01 EXISTING CONDITIONS

- 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 meeting approval of the Project Representative.

3.02 EMBEDDED ITEMS

- A. Do not embed piping in structural concrete unless indicated on the drawings.
- B. Electrical Conduit:
 - 1. Locate to maintain maximum strength of the structure.
 - 2. Increase the thickness of the concrete if the outside diameter exceeds 30 percent of the thickness of the concrete. Obtain written approval of the Project Representative prior to increasing the thickness of the concrete.

3. Electrical conduit to be embedded in concrete shall be rigid galvanized steel conduit. Aluminum conduit is prohibited for embedment in concrete.
- C. Set and secure bolts, inserts, and other required items in the precise locations needed so they are not displaced. Take photos to document locations of embedded items.
- D. Prior to concrete placement, assure the actual locations of embedded items are noted on the as-built set of drawings.

3.03 FORMS

- A. Design, erect, support, brace, and maintain formwork to safely support vertical and lateral loads, which will be applied until such loads can be supported safely by the concrete structure.
- B. Construct forms to the exact sizes, shapes, lines, and dimensions shown, and as required to obtain accurate alignment, location, grades, and level and plumb work in the finished structure.

3.04 MIXING CONCRETE

- A. On Site Mixing of the concrete shall be in accordance with provisions of ACI 301. Mix in drum type batch mixer, complying with ASTM C685.
- B. Transit Mixers: Concrete mixing shall be in accordance with ACI 301. Ready mix concrete shall conform to ASTM C94.
- C. Do not use concrete that has stood for over 30 minutes after leaving the batch plant, or concrete that is not placed within 90 minutes after water is first introduced into the mix.
- D. Do not add additional water to the concrete mix after it has left the batch plant unless prior approval is obtained from the Project Representative.

3.05 PLACING CONCRETE

- A. Preparation:
 1. Remove foreign matter accumulated in the forms.
 2. Rigidly close openings left in the formwork.
 3. Wet wood forms sufficiently to tighten up cracks; wet other material sufficiently to maintain workability of the concrete.
 4. Use only clean tools.
- B. Conveying:
 1. Perform concrete placing at such a rate that concrete, which is being integrated with fresh concrete is still plastic.
 2. Deposit concrete as nearly as practicable in its final location so as to avoid separation due to re-handling and flowing.
 3. Do not use concrete, which becomes non-plastic and unworkable, or does not meet required quality control limits, or has been contaminated by foreign materials.
 4. Remove concrete from the work site that does not meet specifications.

- C. Placing Concrete In Forms:
 - 1. Deposit concrete in horizontal layers not deeper than 24 inches, and avoid inclined construction joints.
 - 2. Remove temporary spreaders in forms when concrete has reached the elevation of the spreaders.

- D. Placing Concrete Slabs:
 - 1. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
 - 2. Bring slab surfaces to the correct level with a straightedge, and then strike off.
 - 3. Use bullfloats or darbies to smooth the surface, leaving the surface free from bumps and hollows.
 - 4. Do not sprinkle water on the plastic surface.
 - 5. Do not disturb the slab surface prior to start of finishing operations.

- E. Place all concrete in accordance with ACI 301.

3.06 CONSOLIDATION

- A. Comply with recommendations of ACI 309R.

- B. Consolidate each layer of concrete while placing by use of internal concrete vibrators and supplemented by hand spading, rodding, or tamping.

- C. Do not vibrate forms or reinforcement.

- D. Do not use vibrators to transport concrete inside the forms.

3.07 JOINTS

- A. Construction Joints:
 - 1. Unless shown otherwise, do not use horizontal construction joints.
 - 2. If construction joints are found to be required, submit for the Project Representative's approval of joint design and location prior to start of concrete placement.
 - 3. Extend all reinforcing continuous through construction joints or provide dowels with proper lap lengths at construction joints, unless indicated otherwise on the Drawings.

- B. Expansion Joints:
 - 1. Do not permit reinforcement or other embedded metal items that are being bonded with concrete (except dowels in floors bonded on only one side of the joints) to extend continuously through any expansion joint.
 - 2. Fill expansion joints full depth with expansion joint material.

3.08 CONCRETE FINISHING

- A. Unless otherwise indicated, provide the following finishes at the indicated locations:
 - 1. Float finish: apply to all surfaces including those that are to receive trowel finish and other finishes specified hereinafter.
 - 2. Trowel finish: apply to surfaces that are to be exposed to view, unless otherwise noted.

3. Non-slip broom finish: apply to equipment pads, walks, stairs, drives, ramps and similar pedestrian and vehicular areas.

3.09 CURING AND PROTECTION

- A. Comply with requirements of ACI 308.1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete:
 1. Normal concrete: Not less than 7 days.
 2. High early strength concrete: Not less than 4 days.
- C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.
- D. Surfaces Not in Contact with Forms:
 1. Start initial curing as soon as free water has disappeared and before surface is dry. Keep continuously moist for specified curing period by water ponding, water-saturated sand, water-fog spray, saturated burlap, or special blankets designed for curing concrete and maintaining moist condition.
 2. Begin final curing after initial curing but before surface is dry.
- E. After completion of curing process, finished surface where indicated shall be protected by use of protection boards from workman, equipment, scaffolding, and any other form of damage throughout subsequent construction. Size, thickness, and material of board shall be determined by Contractor. Contractor is responsible for maintaining integrity of slab finish throughout construction.

3.10 FIELD QUALITY CONTROL

- A. Be responsible for Quality Control of Work for materials, placement, curing, and finishing.
- B. Perform tests of concrete and concrete materials to ensure conformance with specified requirements per ACI 318. Owner may perform spot checks. Owner testing does not relieve the Contractor for quality control and documentation of its Work.
- C. Compressive Strength Tests: ASTM C39. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 50 cu yd or less of concrete placed per day.

END OF SECTION

SECTION 03_60_00

GROUTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Cement grout.
 - 2. Epoxy grout.
 - 3. Non-shrink epoxy grout.
 - 4. Non-shrink grout.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-inch cube specimens).
 - 2. C230 - Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.
 - 3. C531 - Standard Test Method for Liner Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - 4. C579 - Standard Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacing and Polymer Concretes.
 - 5. C939 - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
 - 6. C942 - Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory.
 - 7. C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
 - 8. C1181 - Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.
- B. International Concrete Repair Institute (ICRI):
 - 1. 310.2R - Selecting and specifying Concrete Surface Preparations for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

1.03 SUBMITTALS

- A. Cement grout:
 - 1. Mix design.
 - 2. Material submittals.
- B. Non-shrink epoxy grout:
 - 1. Manufacturer's literature.
- C. Non-shrink grout:
 - 1. Manufacturer's literature.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to jobsite in their original, unopened packages or containers, clearly labeled with manufacturer's product identification and printed instructions.
- B. Store materials in cool dry place and in accordance with manufacturer's recommendations.
- C. Handle materials in accordance with the manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Non-shrink epoxy grout:
 - 1. Manufacturers: One of the following or equal:
 - a. Five Star Products, Inc., Five Star DP Epoxy Grout.
 - b. BASF Construction Chemicals, Masterflow 648 CP Plus.
 - c. L&M Construction Chemicals, Inc., EPOGROUT.
 - 2. Non-shrink epoxy grout shall be 100 percent solid, premeasured, prepackaged system containing 2-component thermosetting epoxy resin and inert aggregate.
 - 3. Shrinkage or expansion: Less than 0.0006 inches per inch when tested in accordance with ASTM C531.
 - 4. Minimum compressive strength: 10,000 pounds per square inch at 24 hours and 14,000 pounds per square inch at 7 days when tested in accordance with ASTM C579, Method B.
 - 5. Compressive creep: Not exceed 0.0037 inches/per inch when tested under 400 pounds per square inch constant load at 140 degrees Fahrenheit in accordance with ASTM C1181.
- B. Non-shrink grout:
 - 1. Manufacturers: One of the following or equal:
 - a. Five Star Products, Inc., Five Star Grout.
 - b. BASF Construction Chemicals, Masterflow 928.
 - c. L&M Construction Chemicals, Inc., CRYSTEX.
 - 2. In accordance with ASTM C1107.
 - 3. Preportioned and prepackaged cement-based mixture.
 - 4. Contain no metallic particles such as aluminum powder and no metallic aggregate such as iron filings.
 - 5. Require only addition of potable water.
 - 6. Water for pre-soaking, mixing, and curing: Potable water.
 - 7. Free from emergence of mixing water from within or presence of water on its surface.
 - 8. Remain at minimum flowable consistency for at least 45 minutes after mixing at 45 degrees Fahrenheit to 90 degrees Fahrenheit when tested in accordance with ASTM C230:
 - a. If at fluid consistency, verify consistency in accordance with ASTM C939.
 - 9. Dimensional stability (height change):
 - a. In accordance with ASTM C1107, volume-adjusting Grade B or C at 45 degrees Fahrenheit to 90 degrees Fahrenheit.
 - b. Have 90 percent or greater bearing area under bases.

10. Have minimum compressive strengths at 45 degrees Fahrenheit to 90 degrees Fahrenheit in accordance with ASTM C1107 for various periods from time of placement, including 5,000 pounds per square inch at 28 days when tested in accordance with ASTM C109 as modified by ASTM C1107.

2.02 MIXES

- A. Cement grout:
 1. Use same sand-to-cementitious materials ratio for cement grout mix that is used for concrete mix.
 2. Use same materials for cement grout that are used for concrete.
 3. Use water-to-cementitious materials ratio that is no more than that specified for concrete.
 4. For spreading over surfaces of construction or cold joints.
- B. Epoxy grout:
 1. Consist of mixture of epoxy or epoxy gel and sand:
 - a. Epoxy: As specified in Section 03_63_01 - Epoxies.
 - b. Epoxy gel: As specified in Section 03_63_01 - Epoxies.
 - c. Sand: Clean, bagged, graded, and kiln-dried silica sand.
 2. Proportioning:
 - a. For horizontal work: Consist of mixture of 1 part epoxy with not more than 2 parts sand.
 - b. For vertical or overhead work: Consist of 1 part epoxy gel with not more than 2 parts sand.
- C. Non-shrink epoxy grout:
 1. Mix in accordance with manufacturer's installation instructions.
- D. Non-shrink grout:
 1. Mix in accordance with manufacturer's installation instructions such that resulting mix has flowable consistency and is suitable for placing by pouring.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect concrete surfaces to receive grout and verify that they are free of ice, frost, dirt, grease, oil, curing compounds, paints, impregnations, and loose material or foreign matter likely to reduce bond or performance of grout or mortar.

3.02 PREPARATION

- A. Surface preparation for grouting other baseplates:
 1. Remove grease, oil, dirt, dust, curing compounds, laitance, and other deleterious materials that may affect bond to concrete and bottoms of baseplates.
 2. Roughen concrete surfaces in contact with grout to ICRI CSP-6 surface profile or rougher:
 - a. Remove loose or broken concrete.
 3. Metal surfaces in contact with grout: Grit blast to white metal surface.

3.03 INSTALLATION

- A. Mixing:
 - 1. Cement grout:
 - a. Use mortar mixer with moving paddles.
 - b. Pre-wet mixer and empty out excess water before beginning mixing.
 - 2. Non-shrink epoxy grout:
 - a. Keep temperature of non-shrink epoxy grout from exceeding manufacturer's recommendations.
 - 3. Non-shrink grout:
 - a. May be drypacked, flowed, or pumped into place. Do not overwork grout.
 - b. Do not retemper by adding more water after grout stiffens.

- B. Placement:
 - 1. Cement grout:
 - a. Exercise care in placing cement grout because it is required to furnish structural strength, impermeable water seal, or both.
 - b. Do not use cement grout that has not been placed within 30 minutes after mixing.
 - 2. Epoxy grouts:
 - a. Wet surfaces with epoxy for horizontal work or epoxy gel for vertical or overhead work prior to placing epoxy grout.
 - 3. Non-shrink epoxy grout:
 - a. Mix in complete units. Do not vary ratio of components or add solvent to change consistency of mix.
 - b. Pour hardener into resin and mix for at least 1 minute and until mixture is uniform in color. Pour epoxy into mortar mixer wheelbarrow and add aggregate. Mix until aggregate is uniformly wetted. Over mixing will cause air entrapment in mix.
 - 4. Non-shrink grout:
 - a. Add non-shrink cement grout to premeasured amount of water that does not exceed the manufacturer's maximum recommended water content.
 - b. Mix in accordance with manufacturer's instructions to uniform consistency.

- C. Curing:
 - 1. Cement based grouts:
 - a. Keep continuously wet for minimum of 7 days. Use wet burlap, soaker hose, sun shading, ponding, and in extreme conditions, combination of methods.
 - b. Maintain above 40 degrees Fahrenheit until it has attained compressive strength of 3,000 pounds per square inch, or above 70 degrees Fahrenheit for minimum of 24 hours to avoid damage from subsequent freezing.
 - 2. Epoxy based grouts:
 - a. Cure grouts in accordance with manufacturers' recommendations:
 - 1) Do not water cure epoxy grouts.
 - b. Do not allow any surface in contact with epoxy grout to fall below 50 degrees Fahrenheit for minimum of 48 hours after placement.

- D. Grouting equipment bases, baseplates, soleplates, and skids: As specified in Section 46_05_10 - Common Work Results for Mechanical Equipment.

- E. Grouting other baseplates:
 - 1. General:
 - a. Use non-shrink grout as specified in this Section.
 - b. Baseplate grouting shall take place from one side of baseplate to other in continuous flow of grout to avoid trapping air in grout.
 - c. Maintain hydrostatic head pressure by keeping level of grout in headbox above bottom of baseplate. Fill headbox to maximum level and work grout down.
 - d. Vibrate, rod, or chain non-shrink grout to facilitate grout flow, consolidate grout, and remove trapped air.
 - 2. Forms and headboxes:
 - a. Build forms using material with adequate strength to withstand placement of grouts.
 - b. Use forms that are rigid and liquidtight. Caulk cracks and joints with elastomeric sealant.
 - c. Line forms with polyethylene for easy grout release. Coating forms with 2 coats of heavy-duty paste wax is also acceptable.
 - d. Headbox shall be 4 to 6 inches higher than baseplate and shall be located on one side of baseplate.
 - e. After grout sets, remove forms and trim back grout at 45 degree angle from bottom edges of baseplate.

3.04 FIELD QUALITY CONTROL

- A. Non-shrink epoxy grout:
 - 1. Test for 24-hour compressive strength in accordance with ASTM C579, Method B.
- B. Non-shrink grout:
 - 1. Test for 24-hour compressive strength in accordance with ASTM C942.

END OF SECTION

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SECTION 03_63_01

EPOXIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Epoxy.
 - 2. Epoxy gel.
 - 3. Epoxy bonding agent.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. C881 - Standard Specification for Epoxy-Resin-Base Systems for Concrete.
 - 2. C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
 - 3. D638 - Standard Test Method for Tensile Properties of Plastics.
 - 4. D695 - Standard Test Method for Compressive Properties of Rigid Plastics.

1.03 SUBMITTALS

- A. General: Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product Data: Submit manufacturer's data completely describing epoxy materials:
 - 1. Submit evidence of conformance to ASTM C881. Include manufacturer's designations of Type Grade, Class, and Color.
- C. Quality control submittals:
 - 1. Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

- A. Performance requirements:
 - 1. Store and use products within limitations set forth by manufacturer.
 - 2. Perform and conduct work of this Section in neat orderly manner.

2.02 MATERIALS

- A. General:
 - 1. Moisture tolerant, water-insensitive, two-component epoxy resin adhesive material containing 100 percent solids, and meeting or exceeding the performance properties specified when tested in accordance with the standards specified.

- B. Epoxy: Low viscosity product in accordance with ASTM C881; Types I, II and IV; Grade 1; Class C:
1. Manufacturers: One of the following or equal:
 - a. BASF, MasterInject 1500.
 - b. Dayton Superior, Sure Inject J56.
 - c. Sika Corporation, Sikadur 35 Hi-Mod LV.
 2. Required properties:

Table 1 - Material Properties - Epoxy.		
Property	Test Method	Required Results ("neat")
Tensile Strength (7-day)	ASTM D638	7,100 pounds per square inch, minimum.
Compressive Strength (7-day)	ASTM D695	11,000 pounds per square inch, minimum.
Bond Strength (2-day)	ASTM C882	1,500 pounds per square inch, minimum. Concrete failure before failure of epoxy.
Viscosity (mixed)		250-550 centipoise
Notes:	Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.	

- C. Epoxy gel: Non-sagging product in accordance with ASTM C881, Types I and IV, Grade 3, Class C:
1. Manufacturers: One of the following or equal:
 - a. Dayton Superior, Sure Anchor J50.
 - b. Sika Corp., Sikadur 31, Hi-Mod Gel.
 2. Required properties:

Table 2 - Material Properties - Epoxy Gel.		
Property	Test Method	Required Results ("neat")
Tensile Strength (7-day)	ASTM D638	2,000 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D695	8,000 pounds per square inch, minimum.
Bond Strength (14-day)	ASTM C882	1,500 pounds per square inch, minimum.
Notes:	Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.	

- D. Epoxy bonding agent: Non-sagging product in accordance with ASTM C881, Type II, Grade 2, Class C:
1. Manufacturers: One of the following or equal:
 - a. BASF, MasterEmaco ADH 326.

- b. Dayton Superior, Sure Bond J58.
 - c. Sika Chemical Corp., Sikadur 32 Hi-Mod LPL.
2. Required properties.

Table 3 - Material Properties - Epoxy Bonding Agent		
Property	Test Method	Required Results
Tensile Strength (7-day)	ASTM D638	3,300 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D695	8,300 pounds per square inch, minimum.
Bond Strength (14-days)	ASTM C882	1,800 pounds per square inch, minimum. Concrete failure before failure of epoxy bonding agent.
Pot Life	-	Minimum 35 minutes at 73 degrees Fahrenheit.
Notes:	Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.	

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.
- B. Epoxy:
 - 1. Apply in accordance with manufacturer's installation instructions.
- C. Epoxy gel:
 - 1. Apply in accordance with manufacturer's installation instructions.
 - 2. Use for vertical or overhead work, or where high viscosity epoxy is required.
 - 3. Epoxy gel used for vertical or overhead work may be used for horizontal work.
- D. Epoxy bonding agent:
 - 1. Apply in accordance with manufacturer's installation instructions.
 - 2. Bonding agent will not be required for filling form tie holes or for normal finishing and patching of similar sized small defects.

END OF SECTION

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SECTION 05_12_00
STRUCTURAL STEEL

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
1. Structural steel shapes and plate.
 2. Fasteners and structural hardware:
 - a. All thread rods.
 - b. High-strength bolts.
 3. Welding.
 4. Bolting.

1.02 REFERENCES

- A. American Institute of Steel Construction (AISC):
1. 303 - Code of Standard Practice for Steel Buildings and Bridges.
 2. 360 - Specification for Structural Steel Buildings.
- B. American Iron and Steel Institute (AISI):
1. Steel alloys ("types") as indicated.
- C. American Welding Society (AWS):
1. A5.1 - Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
 2. A5.17 - Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.
 3. A5.20 - Specification for Carbon Steel Electrodes for Flux Cored Arc Welding.
 4. D1.1 - Structural Welding Code - Steel.
- D. ASTM International (ASTM):
1. A6 - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
 2. A36 - Standard Specification for Carbon Structural Steel.
 3. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 4. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 5. A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 6. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 7. A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 8. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
 9. A992 - Standard Specification for Structural Steel Shapes.
 10. F436 - Standard Specification for Hardened Steel Washers.

11. F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength.
 12. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
 13. F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength.
- E. Research Council on Structural Connections (RCSC):
1. Specification for Structural Joints Using High-Strength Bolts (RCSC Specification).

1.03 DEFINITIONS

- A. Snug-tight: At bolted joints, the tightness attained with a few impacts of an impact wrench, or by the full effort of an ironworker using a spud wrench to bring the connected plies into firm contact.

1.04 SUBMITTALS

- A. Product data:
1. Welding electrodes for field welds: Electrode manufacturer's data.
- B. Shop drawings:
1. Fabrication and erection drawings.
- C. Quality control submittals:
1. Welding procedure specifications (WPS) in accordance with AWS D1.1:
 - a. Submit WPS for each type of welded joint used, whether prequalified or qualified by testing:
 - 1) State electrode manufacturer and specific electrodes used.
 - 2) Indicate required AWS qualification for joint.
 - b. Submit WPS with shop drawings that indicate those welds.
 - c. Submit Procedure Qualification Record (PQR) in accordance with AWS D1.1 for welding procedures qualified by testing.
 2. Welder qualifications: For each welding process and position:
 - a. Welder's qualification certificates.
 - b. Contractor's statement that certificate will be "in effect" at the time(s) welding will be performed based on the "Period of Effectiveness" provisions of AWS D1.1.
 3. Steel fabricator's AISC certification.
- D. Test reports:
1. Certified copies of mill tests and analyses made in accordance with applicable ASTM standards, or reports from a recognized commercial laboratory, including chemical and tensile properties of each shipment of structural steel or part thereof having common properties.

1.05 QUALITY ASSURANCE

- A. Certification:
1. Steel fabricators shall be certified by the AISC or other certification acceptable to the Engineer and the building official having jurisdiction.

- B. Welding:
1. Perform welding of structural metals in accordance with AWS D1.1 using welders who have current AWS qualification certificate for the process, position, and joint configuration to be welded.
 2. Make Welding Procedure Specifications available at the locations where welding is performed.
 3. Notify Engineer at least 24 hours before starting shop or field welding.
 4. Engineer may check materials, equipment, and qualifications of welders.
 5. Remove welders performing unsatisfactory work or require requalification.
 6. Engineer may use gamma ray, magnetic particle, dye penetrant, trepanning, or other aids to visual inspection to examine any part of welds or all welds.
 7. Contractor shall bear costs of retests on defective welds.
 8. Contractor shall bear costs in connection with qualifying welders.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping: Deliver structural steel free from mill scale, rust, and pitting.
- B. Storage and protection: Until erection and painting, protect from weather items not galvanized or protected by a shop coat of paint.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Unless otherwise specified or indicated on the Drawings, materials shall conform to the following.

2.02 FASTENERS AND STRUCTURAL HARDWARE

- A. General:
1. Materials: Of domestic manufacture.
 2. Where fasteners and hardware are specified to be galvanized, hot-dip galvanize in accordance with ASTM A153 or ASTM F2329, unless otherwise specified.
- B. All thread rods:
1. Carbon steel:
 - a. In accordance with ASTM A36 unless otherwise indicated on the Drawings.
 - b. High strength all thread rods: In accordance with ASTM F1554, Grade 55.
 - c. Nuts: ASTM A194.
 - d. Washers: ASTM F436.
 2. Galvanized carbon steel:
 - a. In accordance with ASTM A36 unless otherwise indicated on the Drawings, and hot dip galvanized in accordance with ASTM A153.
 - b. High strength galvanized all thread rods: In accordance with ASTM F1554, Grade 55, and galvanized in accordance with ASTM F2329.
 - c. Nuts: ASTM A194, hot-dip galvanized in accordance with ASTM A153.
 - d. Washers: ASTM F436, hot-dip galvanized in accordance with ASTM A153.

- C. Anchor bolts, anchor rods, and post-installed steel anchors: As indicated on the Drawings.
- D. High-strength bolts:
 - 1. Provide high-strength bolt assembly, with nuts, hardened flat washers, and compressible-washer-type direct tension indicators. Provide hot dip galvanized coating.
 - 2. Carbon steel - Galvanized:
 - a. Bolt and nut assemblies fabricated, galvanized, tested for rotational capacity, and shipped accordance with the provisions ASTM F3125, Grade A325 and the RCSC Specification.
 - b. Bolts, nuts, and washers: Hot-dip galvanized in accordance with ASTM F2329.
 - c. Bolts: Plain heavy hex structural bolts in accordance with ASTM F3125, Grade A325, Type 1 and galvanized as specified.
 - d. Nuts: Heavy hex nuts in accordance with ASTM A563, Grade DH, galvanized as specified, and lubricated in accordance with ASTM A563, Supplementary Requirement S1 to minimize galling.
 - e. Washers:
 - 1) Adjacent to normal, oversized, and short-slotted holes: Circular, square or rectangular beveled, clipped, or extra thick washers in accordance with ASTM F436, Type 1 and galvanized as specified. Flat circular washers unless otherwise indicated on the Drawings.
 - 2) Adjacent to long slotted holes: 5/16-inch thick plate washer fabricated from steel conforming to ASTM A36, and galvanized in accordance with ASTM A123.

2.03 SUPPLEMENTARY PARTS

- A. Furnish as required for complete structural steel erection, whether or not such parts and Work are specified or indicated on the Drawings.

2.04 FABRICATION

- A. Shop assembly:
 - 1. Fabricate structural steel in accordance with AISC 360 and AISC 303 unless otherwise specified or modified by applicable regulatory requirements.
 - 2. Where anchors, connections, or other details of structural steel are not specifically indicated on the Drawings or specified, their material, size and form shall be equivalent in quality and workmanship to items specified.
 - 3. Round off sharp and hazardous projections and grind smooth.
 - 4. Take measurements necessary to properly fit work in the field. Take responsibility for and be governed by the measurements and proper working out of all the details.
 - 5. Ensure correct fitting of metalwork.
 - 6. Welded connections:
 - a. Comply with AWS requirements for the metals to be welded.
 - b. Weld only in accordance with approved Welding Procedure Specifications.
 - c. Keep Welding Procedure Specifications readily available for welders and inspectors during fabrication processes.

- B. Galvanized carbon steel:
 - 1. Where galvanizing is required, hot-dip structural steel after fabrication in accordance with ASTM A123.
 - 2. Do not electro-galvanize or mechanically-galvanize unless specified or accepted by Engineer.
 - 3. Re-straighten galvanized items that bend or twist during galvanizing.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions: Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 ERECTION

- A. General:
 - 1. Fabricate structural items to true dimensions without warp or twist.
 - 2. Form welded closures neatly and grind off smooth where weld material interferes with fit or is unsightly.
 - 3. Install structural items accurately and securely, true to level, plumb, in correct alignment and grade, with all parts bearing or fitting structure or equipment for which intended.
 - 4. Do not shift out of alignment, re-drill, re-shape, or force fit fabricated items.
 - 5. Place anchor bolts or other anchoring devices accurately and make surfaces that bear against structural items smooth and level.
 - 6. Rigidly support and brace structural items needing special alignment to preserve straight, level, even, and smooth lines. Keep structural items braced until concrete, grout, or dry pack mortar has hardened for 48 hours minimum.
 - 7. Erect structural steel in accordance with AISC 303 unless otherwise specified or modified by applicable regulatory requirements.
 - 8. Where anchors, connections, and other details of structural steel erection are not specifically indicated on the Drawings or specified, form, locate, and attach with equivalent in quality and workmanship to items specified.
 - 9. Round off sharp or hazardous projections and grind smooth.
- B. Welding: General:
 - 1. Make welds full penetration type, unless otherwise indicated on the Drawings.
 - 2. Remove backing bars and weld tabs after completion of weld. Repair defective welds observed after removal of backing bars and weld tabs.
- C. Welding: Carbon steel:
 - 1. General: In accordance with AWS D1.1:
 - a. Weld ASTM A36 and A992 structural steel, and ASTM A500 and A501 structural tubing with electrodes in accordance with AWS A5.1, using E70XX electrodes; AWS A5.17, using F7X-EXXX electrodes; or AWS A5.20, using E7XT-X electrodes.
 - b. Field repair cut or otherwise damaged galvanized surfaces to equivalent original condition using a galvanized surface repair.

- D. Interface with other products:
 - 1. Where steel members and fasteners come in contact with dissimilar metals (aluminum, stainless steel, etc.), separate or isolate the dissimilar metals with isolating sleeves and washers.

- E. Fasteners: General:
 - 1. Install bolts to project 2 threads minimum, but 1/2 inch maximum beyond nut.
 - 2. All thread rods in drilled holes bonded to concrete with adhesive: Install as specified in Section 03_21_17 - Adhesive-Bonded Reinforcing Bars and All Thread Rods in Concrete.

- F. Fasteners: High-strength carbon steel bolts:
 - 1. Connections with high-strength bolts shall in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts.
 - 2. Joints: Snug-tight:
 - a. Install bolts with washers where required in accordance with RCSC Specification.
 - b. Tighten bolts to bring the connected plies into firm contact. Tightening shall progress systematically beginning with the most rigid part of the joint. More than 1 cycle through the bolt pattern may be required to achieve this condition.
 - c. Verify adequate tightening of bolts by visual observation to confirm that washers have been installed at locations required in accordance with RCSC Specification, and that the plies of the connected parts have been brought into firm contact.

3.03 FIELD QUALITY CONTROL

- A. Provide quality control as specified in Section 01_45_00 - Quality Control.

3.04 FIELD QUALITY ASSURANCE

- A. Provide quality assurance as specified in Section 01_45_00 - Quality Control.

END OF SECTION

SECTION 08_31_14
FLOOR ACCESS DOORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Non-fire-rated floor access doors.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. Standard Specifications for Highway Bridges.
- B. Occupational Safety and Health Administration (OSHA):
 - 1. 29 CFR 1910-Occupational Safety and Health Standards.

1.03 SUBMITTALS

- A. Product data.
- B. Shop drawings: Show the following:
 - 1. Floor access door installation recommendations.
 - 2. Locations of floor access doors.
 - 3. Door size and configuration.
 - 4. Live load capacity.
 - 5. Materials of construction and finishes provided.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Identify type and size of each floor access door in way not to damage finish prior to delivery.
- B. Deliver products only after proper facilities are available.
- C. Deliver and store packaged products in original containers with seals unbroken and labels intact until time of use.
- D. Handle carefully to prevent damage and store on clean concrete surface or raised platform in safe, dry area:
 - 1. Do not dump onto ground.
- E. Protect floor access doors during shipment and storage to prevent warping, bending, and corrosion.

1.05 WARRANTY

- A. Provide manufacturer's warranty against defects in material and workmanship for a period of 5 years.

1.06 MAINTENANCE

- A. Deliver 2 keys for each cylinder lock to Owner.

PART 2 PRODUCTS

2.01 HEAVY-DUTY OFF-STREET FLOOR ACCESS DOORS

- A. Manufacturers: One of the following or equal:
 - 1. The Bilco Co., Model JH-20 or JDH-20 (double leaf).
- B. Style: Double leaf as indicated on the Drawings, aluminum, capable of withstanding minimum Standard Specifications for Highway Bridges, H-20 wheel load with a maximum deflection of 1/150 of the span, live load channel frame, with drainage couplings.
- C. Door leaf: Minimum 1/4 inch, diamond-pattern plate reinforced with stiffeners as required to meet specified live load.
- D. Frame: 1/4-inch channel with anchor flange around perimeter.
- E. Hardware:
 - 1. Hinges: Each leaf equipped with a minimum of 2 heavy forged-brass hinges with stainless steel pins.
 - 2. Lock: Snap lock with removable handle mounted on door leaf.
 - 3. Grip handle: Provide vinyl grip handle designed to release cover for closing.
 - 4. Operating mechanism: Spring operators designed for ease of operation and automatic hold-open arm with release handle.
 - 5. Drainage assembly: Provide 1-1/2-inch drainage coupling located in corner of the channel frame.

2.02 FINISHES

- A. Floor access door finishes:
 - 1. Aluminum: Manufacturer's standard mill finish.
 - 2. Aluminum in contact with dissimilar metals and concrete: Manufacturer's standard bituminous coating.
 - 3. Steel: Manufacturer's standard red oxide primer.
- B. Hardware finishes:
 - 1. Provide optional Type 316 stainless steel hardware throughout, including parts of the latch and lifting mechanism assemblies, hold-open arms, and all brackets, hinges, pins, and fasteners.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine construction to receive floor access door and verify correctness of dimensions and other supporting or adjoining conditions.

3.02 PREPARATION

- A. Coordinate details with other work supporting, adjoining, or requiring floor access doors.
- B. Verify dimensions and profiles for each opening.
- C. Verify that location will serve portion of work to which access is required:
 - 1. Where proposed functional location conflicts with other work, notify the Engineer before installation.
- D. Apply coating to aluminum surfaces that will be in contact with dissimilar metals or concrete when there is none.

3.03 INSTALLATION

- A. Install floor access doors in accordance with manufacturer's instructions.
- B. Ensure correct types and adequate sizes at proper locations.
- C. Securely attach frames to supporting work and ensure doors, frames, and hardware operate smoothly and are free from warp, twist, and distortion.

3.04 ADJUSTING

- A. Adjust doors, frames, and hardware to operate smoothly, freely, and properly without binding.

3.05 CLEANING

- A. Thoroughly clean surfaces of grease, oil, or other impurities; touch up abraded prime coat where applicable.

END OF SECTION

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SECTION 09_96_01

HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Coatings, including coating systems, surface preparation, application requirements, and quality control requirements.

1.02 REFERENCES

- A. ASTM International (ASTM):
 1. D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.
 2. D2200 - Standard Practice for Use of Pictorial Surface Preparation Standards and Guides for Painting Steel Surfaces.
 3. D3359 - Standard Test Methods for Rating Adhesion by Tape Test.
 4. D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.
 5. D4262 - Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
 6. D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 7. D4285 - Standard Test Method for Indicating Oil or Water in Compressed Air.
 8. D4414 - Standard Practice for Measurement of Wet Film Thickness by Notch Gages.
 9. D4417 - Standard Test Methods for Field Measurement of Surface Profile of Blast-Cleaned Steel.
 10. D4541 - Standard Test Methods for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
 11. D4787 - Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates.
 12. D5162 - Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates.
 13. D7234 - Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
 14. E337 - Standard Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures).
 15. F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 16. F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-situ Probes.
- B. International Concrete Repair Institute (ICRI):
 1. 310.2 - Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

- C. NACE International (NACE):
 - 1. SP0178 - Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service.
 - 2. SP0188 - Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
- D. National Association of Pipe Fabricators (NAPF):
 - 1. 500-03 - Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings.
- E. NSF International (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects.
- F. Occupational Safety and Health Administration (OSHA).
- G. Society of Protective Coatings (SSPC):
 - 1. Glossary - SSPC Protective Coatings Glossary.
 - 2. Guide 6 - Guide for Containing Surface Preparation Debris Generated during Paint Removal Operations.
 - 3. Guide 15 - Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates.
 - 4. PA 1 - Shop, Field, and Maintenance Painting of Steel.
 - 5. PA 2 - Procedure for Determining Conformance to Dry Coating Thickness Requirements.
 - 6. PA 9 - Measurement of Dry Coating Thickness Using Ultrasonic Gages.
 - 7. QP 1 - Standard Procedure for Evaluating the Qualifications of Industrial/Marine Painting Contractors.
 - 8. SP 1 - Solvent Cleaning.
 - 9. SP 3 - Power Tool Cleaning.
 - 10. SP 5 - White Metal Blast Cleaning.
 - 11. SP 10 - Near-White Metal Blast Cleaning.
 - 12. SP 11 - Power Tools Cleaning to Bare Metal.
 - 13. SP 13 - Surface Preparation of Concrete.
 - 14. SP 16 - Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
 - 15. SP COM - Surface Preparation Commentary.
 - 16. SP VIS 1 - Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning.
 - 17. SP WJ-1 - Waterjet Cleaning of Metals -- Clean to Bare Substrate.
 - 18. SP WJ-2 - Waterjet Cleaning of Metals -- Very Thorough Cleaning.
 - 19. SP WJ-3 - Waterjet Cleaning of Metals -- Thorough Cleaning.
 - 20. SP WJ-4 - Waterjet Cleaning of Metals -- Light Cleaning.

1.03 DEFINITIONS

- A. Definitions used in this Section are in accordance with definitions referenced in ASTM D16, ASTM D3960, and SSPC Glossary of Definitions.
- B. Specific definitions:
 - 1. Abrasive: Material used for blast cleaning, such as sand, grit, or shot.
 - 2. Abrasive Blast Cleaning: Cleaning/surface preparation by abrasive propelled at high speed.

3. Anchor Pattern: Profile or texture of prepared surface(s).
4. Biogenic Sulfide Corrosion: Corrosion caused by sulfuric acid formed when *Thiobacillus* bacteria metabolizes hydrogen sulfide.
5. Bug Holes: Small cavities resulting when air bubbles are entrapped in the surface of formed concrete during placement and consolidation.
6. System: Protective film with 1 or more coats applied in a predetermined order, including surface preparation and quality control requirements.
7. Coating/Paint/Lining Thickness: Total thickness of primer, intermediate, and/or finish coats after drying or curing.
8. Dew point: Temperature a given air/water vapor mixture starts to condense.
9. Drying Time: Time interval between application and material curing.
10. Dry to Recoat: Time interval between material application and its ability to receive the next coat.
11. Dry to Touch: Time interval between material application and its ability to tolerate a light ouch without coating damage.
12. Exposed Surface: Any indoor or outdoor surface not buried or encased.
13. Feather Edging: Reducing coating thickness at its edge to blend with existing surrounding coating.
14. Feathering: Tapering off a wet edge with a comparatively dry brush.
15. Ferrous: Cast iron, ductile iron, wrought iron, and all steel alloys except stainless steel.
16. Field Coat: Application of a surface coating system at the work site.
17. Finish Coat: Final coat in a paint system, including texture, color, smoothness of surface, and other properties affecting appearance.
18. Hold Point: A defined point, specified in this Section, at which work shall be halted for inspection.
19. Holiday: A discontinuity, skip, void, or pinhole in coating or coating system film that exposes the substrate.
20. Honeycomb: Segregated and porous surface of hardened concrete due to insufficient consolidation.
21. Hydroblast: High or ultra-high pressure water jet surface preparation.
22. Incompatibility: One coating's inability to overlay another coating or surface as evidenced by bleeding, poor bonding, or lifting of old coating; inability of a coating to bond to a substrate.
23. Immersed/Immersion: A service condition in which substrate is submerged, is immediately above liquids, or is subject to frequent wetting, splashing, or washdown.
24. Laitance: A thin, weak, brittle layer of cement and aggregate fines on a concrete surface.
25. Mil: 0.001 inch.
26. Overspray: Dry spray, particularly paint bonded to an unintended surface.
27. Pinhole: A small diameter discontinuity in a coating or coating system film, created by offgassing from a void in a concrete or masonry substrate causing a void between coats or exposing the substrate. Usually caused by coating application while temperature is rising.
28. Pot Life: Time interval after components are mixed and coating can be satisfactorily applied.
29. Prime Coat: First full paint coat applied to a surface when using a multicoat system. Primers adhere to a new substrate, protect the substrate, and promote adhesion of subsequent coats of paint. The prime coat on metal surfaces is the first full coat and does not include solvent wash, grease emulsifiers, or other pretreatment applications.

30. Resurfacer/Resurfacing Material: A layer of cementitious and/or resin-based material used to fill or otherwise restore surface continuity to worn or damaged concrete surfaces.
31. Shelf Life: Maximum storage time a material may be stored without losing its usefulness.
32. Shop Coat: 1 or more coats applied in an off-site shop or plant before shipment to work site where field or finishing coat(s) are applied.
33. Spreading Rate: Area covered by a unit volume of paint at a specific thickness.
34. Stripe Coat: A separate brush coat of paint applied to all weld seams, pits, nuts/bolts/washers, and edges. This coat shall not be applied until previous coats have cured. Once applied, the coat shall be allowed to cure before subsequent coats are applied.
35. Tie Coat: An intermediate coat that bonds different types of paint material, improving succeeding coat adhesion.
36. Thick Film Coating System: A coating system applied with a minimum dry film thickness of 25 mils.
37. Touch-Up Painting: Application of paint on previously painted surfaces to repair marks, scratches, and deteriorated or damaged areas to restore the appearance and performance of the coating.
38. Water Blast: An alternative to air abrasive blast cleaning that can be used with or without abrasive injection. Water cleaning at pressures up to 5,000 pounds per square inch is called low-pressure water cleaning or power washing. High-pressure water cleaning uses water pressures between 5,000 and 10,000 pounds per square inch. Water jetting is water blasting with added abrasive at pressures between 10,000 and 25,000 pounds per square inch. Ultra-high-pressure water jetting is water blasting at pressures above 25,000 pounds per square inch.
39. Weld Splatter: Beads of non-structural weld metal that adhere to the surrounding surface, removed as part of surface preparation.

1.04 ABBREVIATIONS

- A. CSM - Coating System Manufacturer.
- B. CMU - Concrete Masonry Units.
- C. CSA - Coating System Applicator. Specialty subcontractor retained by the Contractor to install the coating systems specified in this Section.
- D. CTR - Coating System Manufacturer's Technical Representative.
- E. DFT - Dry-Film Thickness. Thickness of cured film, usually expressed in mils (0.001 inch).
- F. SSD - Surface Saturated Dry. Refers to concrete surface condition where the surface is saturated (damp) without the presence of standing water.
- G. TPC - Technical Practice Committee.
- H. VOC - Volatile Organic Compound. Portion of the coating that is a compound of carbon, is photochemically reactive, and evaporates during drying or curing; expressed in grams per liter (g/l) or pounds per gallon (lb/gal). VOC is determined by EPA Method 24.

- I. WFT - Wet Film Thickness. Coating thickness as measured immediately after application. Usually expressed in mils (0.001 inch).

1.05 PERFORMANCE REQUIREMENTS

- A. Coating materials shall be formulated for environments encountered in water treatment processes.
- B. Coating materials that come in contact with water distributed as potable water shall be certified in accordance with NSF 61.

1.06 SUBMITTALS

- A. As specified in Section 01_33_00 - Submittal Procedures, submit the following:
 - 1. Schedule of proposed coating materials.
 - 2. Schedule of surfaces to be coated with each coating material.
 - 3. Dehumidification and heating plan.
 - 4. Product data:
 - a. Physical properties of coatings, including the following:
 - 1) Solids content.
 - 2) Ingredient analysis.
 - 3) VOC content.
 - 4) Temperature resistance.
 - 5) Typical exposures and limitations.
 - 6) Manufacturer's standard color chips.
 - b. Compliance with regulatory requirements:
 - 1) VOC limitations.
 - 2) Lead compounds and polychlorinated biphenyls.
 - 3) Abrasives and abrasive blast cleaning techniques and disposal.
 - 4) Methods for tenting blasting areas and methods to protect existing equipment from dust and debris.
 - 5) NSF certification of coatings for potable water supply systems.
 - c. CSM's current printed recommendations and product data sheets for coating systems, including:
 - 1) Surface preparation recommendations.
 - 2) Primer type.
 - 3) Maximum dry and wet-mil thickness per coat and number of coats:
 - a) Coating Coverage Worksheets.
 - 4) Minimum and maximum curing time between coats, including atmospheric conditions for each.
 - 5) Curing time before submergence in liquid.
 - 6) Thinner to be used for each coating.
 - 7) Ventilation requirements.
 - 8) Minimum and maximum atmospheric conditions during which the paint shall be applied.
 - 9) Allowable application methods.
 - 10) Maximum allowable substrate moisture content.
 - 11) Maximum shelf life.
 - 12) Requirements for transportation and storage.
 - 13) Mixing instructions.
 - 14) Shelf life.
 - 15) Material Pot life.

- 16) Precautions for applications free of defects.
 - 17) Method of application.
 - 18) Drying time of each coat, including prime coat.
 - 19) Compatible prime coats.
 - 20) Limits of ambient conditions during and after application.
 - 21) Required protection from sun, wind, and other conditions.
 - 22) Touch-up requirements and limitations.
 - 23) Minimum adhesion of each system submitted in accordance with ASTM D4541 and ASTM D7234.
- d. Samples: Include 8-inch square drawdowns or brushouts of topcoat finish when requested. Identify each sample as to finish, formula, color name and number, sheen name, and gloss units.
 - e. Affidavits signed by an officer of the CSM's corporation attesting to full compliance of each coating system component with current federal, state, and local air pollution control regulations and requirements.
 - f. List of cleaning and thinner solutions allowed by the CSMs.
 - g. Storage requirements, including temperature, humidity, and ventilation for Coating System Materials as recommended by the CSMs.
 - h. Thick film coating systems (greater than 25 mils):
 - 1) CSM's detailed written instructions for coating system treatment and graphic details for coating system terminations in coated structures, including pipe penetrations, metal embedments, gate frames, and other terminations encountered.
 - 2) Include detail treatment for coating system at concrete joints.
 - 3) Manufacturer's Representative's (CTR) Field Reports.
5. Quality assurance submittals:
- a. Quality assurance plan.
 - b. Qualifications of CSA, including:
 - 1) List of Similar Projects:
 - a) Name and address of project.
 - b) Year of installation.
 - c) Year placed in operation.
 - d) Point of contact: Name and phone number.
 - 2) Provide a minimum of 5 project references, each including contact name, address, and telephone number where similar coating work has been performed by their company in the past 5 years.
 - c. CSA Reports:
 - 1) Written daily quality control inspection reports.
 - d. CTR Reports:
 - 1) Reports on visits to project site to view and approve surface preparation of structures to be coated.
 - 2) Reports on visits to project site to observe and approve coating application procedures.
 - 3) Reports on visits to coating plants to observe and approve surface preparation and coating application on shop-coated items.

1.07 QUALITY ASSURANCE

- A. CSA qualifications:
 - 1. Minimum of 5 years of experience applying specified type or types of coatings under conditions similar to those of the Work:
 - a. Provide qualifications of applicator and references listing 5 similar projects completed in the past 5 years.
 - 2. SSPC QP 1 certified.
 - 3. Manufacturer-approved applicator when manufacturer has approved applicator program or when required in these specifications.

- B. CTR qualifications:
 - 1. Certification, one of the following:
 - a. NACE Level 2 or 3 Certified Coating Inspector.
 - b. SSPC Level 3 Protective Coatings Inspector.
 - 2. Minimum of 5 years of experience evaluating application of manufacturer's coatings under conditions similar to those of the Work:
 - a. Provide CTR qualifications and references listing 5 similar projects completed in the past 5 years.

- C. Regulatory requirements: Comply with governing agencies' regulations by using coatings conforming to their VOC limits:
 - 1. Lead-based coatings are not permitted.
 - 2. Do not use coal-tar epoxy in contact with drinking water or exposed to ultraviolet radiation.

- D. Pre-installation conference: Conduct as specified in Section 01_31_19 - Project Meetings:
 - 1. Coordinate Hold Point schedule.

- E. Field samples:
 - 1. Prepare and coat a minimum 10-square-foot area of each system between corners or limits such as control or construction joints.
 - 2. Approved field sample may be part of the Work.

- F. Obtain approval before coating other surfaces. Use products by same manufacturer for prime coats, intermediate coats, and finish coats on same surface, unless specified otherwise.

- G. CSM services:
 - 1. CSA shall arrange for CTR to attend pre-installation conferences.
 - 2. Visit the project site periodically to consult on and inspect specified surface preparation and application Hold Points.
 - 3. Visit coating plants to observe and approve surface preparation procedures and coating application of items to be shop primed and coated.
 - 4. CTR shall provide written inspection reports.

- H. Quality control requirements:
 - 1. Contractor shall be responsible for the workmanship and quality of the coating system installation:
 - a. Inspections by Owner, Engineer, CSA, or CTR will not relieve or limit Contractor's responsibilities.

2. Conform to this specification's requirements and the standards referenced in this Section. Changes in the coating system application requirements will be allowed only with the Engineer's written acceptance.
3. Specially trained crews with experience applying the specified coating system coating are required for:
 - a. Coating application using plural component spray equipment or other specialty equipment.
 - b. Coating with specialty linings for severe service conditions, including floor coatings, and with linings for corrosive headspaces or secondary containment areas.
4. CTR shall specially train personnel for coating systems as specified in Appendix B Coating Detail Sheets:
 - a. CSM shall approve personnel in writing applying the coating system.
5. Do not use contaminated, outdated, diluted materials, and/or materials from previously opened containers.
6. Identify inspection access points used by Owners or Engineers.
7. Provide ventilation, ingress, egress, or other means as necessary for Owner's or Engineer's personnel to safely access the work areas.
8. Conduct and continually inspect work so the coating system is installed as specified. The CSM shall provide written directions to correct coating work not conforming to the specifications or is otherwise unacceptable.
9. Provide written daily reports summarizing test data, work progress, surfaces covered, ambient conditions, quality control inspection test findings, and other information pertinent to the coating system application:
 - a. Determine relative humidity in accordance with ASTM E337. Confirm other conditions, such as proper protective measures for surfaces not to be coated and safety requirements for personnel:
 - 1) Measure daily at shift's beginning and end and at intervals not to exceed 4 hours during the shift.
 - 2) Determine the acceptability of weather and/or environmental conditions within the structure in accordance with the CSM's requirements.
 - b. Monitoring surface preparation: Spot check cleanliness, surface profile, and surface pH testing at least 3 times daily. Check each surface at least once. In accordance with:
 - 1) ASTM D4262.
 - 2) ASTM D4263.
 - 3) ASTM D4417.
 - 4) ICRI 310.2 requirements.
 - 5) SSPC Surface Preparation Standards.
 - c. Confirm that compressed air used for surface preparation or blow-down cleaning is free of oil and moisture.
 - d. Monitor surface preparation daily at shift's beginning and end and at intervals not to exceed 4 hours during the shift.
 - e. Do not apply coatings when environmental conditions are outside of the CSM's published limits.
 - f. Monitoring coatings application: Continuously inspect, measure, and record the wet film thickness and general film quality (visual inspection) for runs, sags, pinholes, holidays, etc. during coating:
 - 1) Perform WFT measurements in accordance with ASTM D4414.
 - g. Post cure evaluation: Measure and inspect the overall dry film thickness on all surfaces. Conduct a DFT survey and perform adhesion testing,

holiday detection, or cure testing as required in this Section and/or the CSM's written instructions. Perform all applicable tests in accordance with ASTM D4541, ASTM D4787, ASTM D5162, ASTM D7234, SSPC-PA 1, SSPC-PA 2, SSPC-PA 9, and other pertinent standards and recommended practices.

- I. Inspection at Hold Points:
 1. Conduct inspections at Hold Points during the coating system application and record the results.
 2. Coordinate Hold Points with the Engineer so the Engineer can observe Contractor's inspections on a scheduled basis.
 3. Provide the Engineer a minimum of 24 hours of notice before conducting Hold Point Inspections.
 4. Coatings application: At the beginning of coating system application, measure, record, and confirm acceptability of surface and ambient air temperature and humidity. Inspect applicator's equipment for serviceability and suitability for coatings application:
 - a. Observe conditions during the Pre-application Meeting.

1.08 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products as specified in Section 01_60_00 - Product Requirements.
- B. Immediately remove unspecified and unapproved coatings from Project site.
- C. Deliver new labeled, unopened containers:
 1. Do not deliver materials after manufacturer's expiration date or over 12 months from manufacturing date, whichever is more stringent. Store materials in well-ventilated enclosed structures and protect from weather and excessive heat or cold in accordance with the CSM's recommendations:
 - a. Store flammable materials in accordance with federal, state, and local requirements.
 - b. Store rags and cleanup materials appropriately to prevent fire and spontaneous combustion.
 2. Store and dispose of hazardous waste in accordance with federal, state, and local requirements. This requirement specifically applies to waste solvents and coatings.
 3. Container labels shall show the following:
 - a. Brand name or product title.
 - b. CSM's batch number.
 - c. CSM's manufacture date.
 - d. CSM's name.
 - e. Generic material type.
 - f. Application and mixing instructions.
 - g. Hazardous material identification label.
 - h. Shelf life expiration date.
 - i. Color.
 - j. Mixing and reducing instructions.
 4. Clearly mark containers to indicate safety hazards associated with the use of or exposure to materials.

1.09 PROJECT CONDITIONS

- A. Apply coatings to dry surfaces:
1. Surface moisture: Comply with manufacturer's requirements or as specified in this Section:
 - a. Plaster and gypsum wallboard: 12 percent.
 - b. Masonry and concrete block: 12 percent.
 - c. Concrete floors: Moisture vapor transmission rate of no more than 3.0 pounds per 1,000 square feet per 24 hours in accordance with ASTM F1869 or relative humidity no greater than 80 percent if tested in accordance with ASTM F2170 unless the CSM's recommendations are more restrictive.
 - d. Concrete structures: Negative results from Plastic Sheet Test in accordance with ASTM D4263, and maximum of 80 percent relative humidity in accordance with ASTM F2170.
- B. Do not apply coatings when the following conditions exist. If such conditions exist, provide containment, covers, environmental controls, and other necessary measures:
1. During rainy, misty, or damp weather, or to surfaces with frost or condensation.
 2. When the surface temperature is below 10 degrees Fahrenheit above the dew point.
 3. When ambient or surface temperature:
 - a. Is less than 55 degrees Fahrenheit unless manufacturer allows a lower temperature.
 - b. Is less than 65 degrees Fahrenheit for clear finishes, unless manufacturer allows a lower temperature.
 - c. Exceeds 90 degrees Fahrenheit, unless manufacturer allows a higher temperature.
 - d. Exceeds manufacturer's recommendation.
 4. When relative humidity is higher than 85 percent.
 5. Under dusty or adverse environmental conditions.
 6. When light on surfaces measures less than 15 foot-candles.
 7. When wind speed exceeds 15 miles per hour.
- C. Apply coating only under evaporation conditions rather than condensation:
1. Use dehumidification equipment, fans, and/or heaters inside enclosed areas to maintain required atmospheric and surface temperature requirements for proper coating application and cure.
 2. Measure and record relative humidity and air and surface temperatures at the start and end of each shift to confirm proper humidity and temperature levels inside the work area:
 - a. Submit test results.
- D. Continuously ventilate, dehumidify, and heat enclosed spaces with high humidity during surface preparation, coating application, and curing:
1. Maintain minimum air temperature of 55 degrees Fahrenheit and 10 degrees Fahrenheit above the dew point.
 2. Maintain dew point of at least 10 degrees Fahrenheit less than the temperature of the coldest part of the structure where work is performed.

3. Reduce dew point temperature in conditioned space by at least 10 degrees Fahrenheit within 20 minutes.
4. Seal work areas and maintain positive pressure per dehumidification equipment supplier's recommendations.
5. Maintain these conditions before, during, and after application to ensure proper adhesion and cure of coatings for no less than:
 - a. Entire curing period.
 - b. 8 hours after coating.

E. Systems:

1. Site electrical power availability as specified in Section 01_50_00 - Temporary Facilities and Controls.
2. Internal combustion engine generators may be used:
 - a. Obtain required permits and provide air pollution and noise control devices on equipment as required by permitting agencies require.
 - b. Comply with state, federal, and local fire and explosion protection measures when locating and operating generator.
 - c. Locate engine generator outside hazardous classified areas per NFPA 820.
 - d. Provide daily fuel service for generator for duration of use.
3. Dehumidification:
 - a. Provide desiccant or refrigeration drying.
 - b. Use only desiccant types with a rotary desiccant wheel capable of continuous operation.
 - c. Liquid, granular, or loose lithium chloride drying systems are not acceptable.
4. Heating:
 - a. Use electric, indirect combustion, or steam coil.
 - b. Direct-fired combustion heaters are not acceptable heat sources during abrasive blasting, coating application, or coating cure.
5. Filters:
 - a. Use a filtration system for dust removal designed to not interfere with dehumidification equipment's ability to control dew point and relative humidity inside the reservoir.
 - b. Do not allow air from the working area or dust filtration equipment to recirculate through their dehumidifier during coating application or when solvent vapors are present.
6. Design and submittals:
 - a. Prepare and submit dehumidification and heating plan, including all equipment and operating procedures.
 - b. Suppliers of services and equipment shall have at least 3 years of experience in similar applications.

1.10 MAINTENANCE

- A. Provide table of products applied organized by surface type. List coating manufacturer, color, color formulation, distributor name, telephone number, and address.
- B. Provide extra materials:
 1. Minimum 1 gallon of each type and color of coating applied or provide additional quantities if specified in the Contract Documents.

2. Deliver unopened factory-labeled cans when manufacturer packages material in gallon cans.
3. Deliver material in new gallon containers, properly sealed and identified with permanently affixed, durable, printed labels indicating brand, type, and color, when manufacturer does not package material in gallon cans, deliver.

1.11 CTR RESPONSIBILITIES

- A. General:
 1. Attend pre-installation conference.
 2. Perform onsite application training.
 3. Periodically inspect coating system application.
- B. Coating system installation training:
 1. Provide a minimum of 8 hours of classroom and off-site training for application personnel and supervisory personnel in one of the following ways:
 - a. Train a minimum of 2 supervisory personnel and 2 application personnel.
 - b. Submit a letter from the CSM stating that CSM approves the supervisory and application personnel, listed by name and responsibility, and no additional training is required.
 2. CTR can train up to 14 application personnel and 3 supervisory personnel at a time.
 3. Minimum training requirements:
 - a. Explain in detail the mixing, application, curing, and termination requirements.
 - b. Provide hands-on demonstration of coating system mixing.
 - c. Explain in detail the ambient condition requirements for temperature and humidity.
 - d. Explain in detail the surface preparation requirements.
 - e. Explain in detail the re-coat times, cure times, and related ambient condition requirements.
 - f. Write a letter stating that training was satisfactorily completed by the personnel, listed by name and responsibility.
 4. Provide special training as specified in the Coating Detail Sheets.
- C. Coating system inspection:
 1. CTR inspection is in addition to the CSA's inspection as specified in this Section.
 2. Be on-site to oversee:
 - a. Coating application at least once a week.
 - b. End of surface preparation.
 - c. During coating application.
 - d. Post-cure inspection.
 3. Routinely inspect and verify in writing that application personnel have successfully performed surface preparation, filler/surfacer application, coating system application, and Quality Control Inspection in accordance with this Section and to warrantable quality.
 4. Perform the following activities to confirm conformance with the specifications:
 - a. Inspect ambient conditions during coating system installation at Hold Points for conformance with the specified requirements.

- b. Inspect each coated surface type and coating system applied to verify the following:
 - 1) Cleanliness.
 - 2) Surface pH for concrete substrates.
 - 3) Confirm surface preparation of substrates where coating system will terminate or will be applied for conformance to the specified application criteria.
- c. Verify surface profile of substrates by completing the following:
 - 1) Inspect preparation and application of coating detail treatment at terminations, transitions, metal embedments in concrete, and joints and cracks in substrates.
 - 2) Inspect application of filler/surfacer materials for concrete and masonry substrates.
 - 3) Verify proper mixing of coating materials.
 - 4) Inspect application of primers and finish coats, including wet and dry film thickness.
 - 5) Inspect coating systems for proper cure times and conditions.
- d. Review adhesion testing of cured coating systems.
- e. Review coating system continuity testing.
- f. Inspect and record representative-localized repairs.
- g. Conduct final review of completed coating system installation.
- h. Prepare and submit site visit reports after each site visit to document that the coating work is in accordance with the CSM's Recommendations.

D. Final report:

- 1. Prepare a final report, after coating work ends, summarizing each day's test data, observations, drawings, and photographs. Include substrate conditions, ambient conditions, and application procedures observed during the CTR's site visits. Include a statement that completed work was performed in accordance with the requirements of the CSM's recommendations.

PART 2 PRODUCTS

2.01 MATERIALS

A. General:

- 1. Product requirements as specified in Section 01_60_00 - Product Requirements.

2.02 COATING SYSTEMS IDENTIFICATION

- A. Naming Conventions: Coating Systems Identifications contain the elements defined in Table 1:

Table 1 Coating System Identification Elements						
First Element	-	Second Element	-	Third Element	-	Fourth Element (optional)
3 or 4 alpha characters		1-3 alpha characters		1 number		3 or 4 alpha characters
Coating Type		Substrate		System Number		Additional Substrate or Special Condition
Example: EPX	-	C	-	6	-	BSC

1. First element identifies the coating type using the following abbreviations:
 - a. ACR: acrylic.
 - b. CTE: coal tar epoxy.
 - c. ELA: elastomeric acrylic.
 - d. EPU: epoxy-polyurethane.
 - e. EPX: epoxy.
 - f. POL: polyurethane.
 - g. SIL: silicone.
 - h. SILX: siloxane or silane.
 - i. VE: vinyl ester.
2. Second element identifies the substrate using the following abbreviations:
 - a. C: concrete or masonry.
 - b. F: concrete flooring.
 - c. FRP: fiber-reinforced plastic.
 - d. GM: galvanized metal.
 - e. M: metal.
 - f. PVC: polyvinyl chloride, chlorinated polyvinyl chloride.
3. Third element identifies the sequential system number:
 - a. For example, EPX-C-2 is the second standard epoxy coating system for concrete substrates.
4. Fourth element is optional and identifies the additional substrate or special condition with the following abbreviations:
 - a. PWS: Potable water service applications (NSF-61 approved).
 - b. BSC: Biogenic sulfide corrosion-resistant applications in wastewater.
 - c. BG: Below grade or buried.
 - d. OZ: Organic zinc primer, epoxy polyurethane system.
 - e. SC: Secondary containment.

2.03 PRODUCTS FOR COATING SYSTEMS

- A. Products: As specified in Appendix B Coating Detail Sheets.
- B. Cleaning solvents:
 1. Requirements for solvent wash, solvent wipe, or cleaner used, including, but not limited to, those used for surface preparation in accordance with SSPC-SP 1:
 - a. Emulsifying type.
 - b. Containing no phosphates.
 - c. Biodegradable.

- d. Does not damage zinc.
 - e. Compatible with the specified primer.
 - f. Complying with applicable air-quality control board requirements.
2. Use clean white cloths and clean fluids in solvent cleaning.

PART 3 EXECUTION

3.01 GENERAL PROTECTION REQUIREMENTS

- A. Protect adjacent coated surfaces from coatings and damage associated with coating work. Repair damage resulting from inadequate or unsuitable protection.
- B. Use drop cloths and other coverings to protect adjacent surfaces not to be coated against spatter and droppings.
- C. Mask off surfaces of items not to be coated or remove items from area.
- D. Furnish and deploy sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being coated and, in particular, surfaces within storage and preparation areas.
- E. Place coating waste, cloths, and material that may pose a fire hazard in closed metal containers and remove daily from site.
- F. Remove electrical plates, surface hardware, fittings, and fasteners before coating application. Carefully store, clean, and replace items after completing coating in each area. Do not use solvent or degreasers to clean hardware that may remove permanent lacquer finishes.
- G. Erect and maintain protective enclosures in accordance with SSPC- Guide 6.
- H. Protect the following surfaces from abrasive blasting by masking or by other means:
 1. Threaded portions of valve and gate stems, grease fittings, and identification plates.
 2. Machined surfaces for sliding contact.
 3. Surfaces to be assembled against gaskets.
 4. Surfaces of shafting where sprockets will be fit.
 5. Surfaces of shafting where bearings will be fit.
 6. Machined bronze surfaces, including slide gates.
 7. Cadmium-plated items, except cadmium-plated, zinc-plated, or sherardized fasteners used to assemble equipment requiring abrasive blasting.
 8. Galvanized items, unless scheduled to be coated.
- I. Protect installed equipment, mechanical drives, and adjacent coated equipment from abrasive blasting to prevent damage caused by spent abrasive blast media, dust, or dirt entering such equipment.
- J. Schedule cleaning and coating to keep dust and spray from the cleaning process from falling on wet, newly coated surfaces:
 1. Whenever possible, coordinate with other trades and complete surface preparation and coating work before installing hardware, hardware accessories, nameplates, data tags, electrical fixtures, and similar uncoated

- items that will be in contact with coated surfaces. Mask machined surfaces, sprinkler heads, and other small items that will not be coated.
2. After completing coating, reinstall removed items.
 3. Disconnect and move equipment adjacent to walls to clean and coat equipment and walls. Replace and reconnect equipment after coating.

3.02 GENERAL SURFACE PREPARATION REQUIREMENTS

- A. Prepare surfaces in accordance with CSM's instructions unless more stringent requirements are specified in this Section.
- B. Coating detail sheets in Appendix B include additional surface preparation requirements.
- C. Follow more stringent requirement if information conflicts.
- D. Where required by the Owner's representative, a **NACE International certified coatings inspector, provided by the Owner**, will inspect and approve surfaces to be coated before applying a coating:
 1. CSA shall coordinate coating inspections:
 - a. Identify coating inspection Hold Points during the pre-installation conference.
 - b. Provide at least 2 days' notice before inspection.
 2. Contractor shall correct surface defects identified by the inspector at no additional cost to Owner.

3.03 MECHANICAL AND ELECTRICAL EQUIPMENT PREPARATION

- A. Identify equipment, ducting, piping, and conduit as specified in Section 46_05_11 - Equipment Identification, and Section 40_05_00.03 - Pipe Identification.
- B. Remove grilles, covers, and access panels for mechanical and electrical system and coat separately.
- C. Prepare and finish coat equipment primed by the manufacturer using specified intermediate and top coats, as applicable, and color selected by the Owner.
- D. Prepare, prime, and coat both insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars, and supports, except where items are covered with material not requiring coating, or with a prefinished coating.
- E. Replace identification markings on mechanical or electrical equipment when coated over or spattered.
- F. Prepare and coat interior surfaces of air ducts and convactor and baseboard heating cabinets visible through grilles and louvers with 1 coat of flat black paint to limit of sight line.
- G. Prepare and coat dampers exposed immediately behind louvers, grilles, and convactor and baseboard heating cabinets to match face panels.

- H. Prepare and coat exposed conduit and appurtenances occurring in finished areas with color and texture to match adjacent surfaces.
- I. Prepare and coat sides' front, back, and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.
- J. Color code equipment, piping, conduit, and exposed ductwork and apply color banding and identification, such as flow arrows, naming, and numbering, in accordance with the Contract Documents.

3.04 CLEANING OF NEW AND PREVIOUSLY COATED OR NEW SURFACES

- A. Utilize cleaning agent to remove soluble salts, such as chlorides, from concrete and metal surfaces:
 - 1. Cleaning agent: Biodegradable non-flammable and containing no VOC.
 - 2. Manufacturers: The following or equal:
 - a. CHLOR*RID International, Inc.:
 - 1) Complete soluble salt removal with steam or warm water cleaning.
 - 3. Clean surfaces with decontamination agent in conjunction with abrasive blast cleaning, steam cleaning, high-pressure washing, or hand washing, as approved by the CTR and the Engineer.
 - 4. Test cleaned surfaces to ensure removal of soluble salts. Carry out additional cleaning as needed.
 - 5. Complete final surface preparation before applying new coating system in strict accordance with CSM's printed instructions.

3.05 BLAST CLEANING

- A. Surface preparation requirements:
 - 1. Do not reuse spent blast abrasive.
 - 2. Ensure that filter compressed air used for blast cleaning is free of condensed water and oil. Clean moisture traps at least once every 4 hours or more frequently, as required, to prevent moisture from entering the abrasive blasting equipment air supply. Check blast air for moisture and oil after each cleaning in accordance with ASTM D4285.
 - 3. Install oil separators just downstream of compressor discharge valves and at the discharge point of blast pot discharges. Check separators on the same frequency as the moisture traps.
 - 4. Keep regulators, gauges, filters, and separators on compressor air lines to blasting nozzles operational at all times.
 - 5. Install an air dryer or desiccant filter drying unit to dry the compressed air before blast pot connections. Use and maintain the dryer throughout surface preparation work.
 - 6. Use a venturi-type, or other high velocity-type, abrasive blast nozzles supplied with at least 100 pounds per square inch gauge air pressure at the nozzle and enough volume to obtain appropriate blast cleaning production rates and surface cleanliness.
 - 7. Provide airborne particulate evacuation and filtering that meets OSHA safety standards. Maintain optimal visibility both to clean and provide the specified surface profile and to allow inspection of the substrate during surface preparation work.

8. If prepared and cleaned metallic substrates become contaminated between final surface preparation work and coating system application, or if the prepared substrate darkens or changes color, re-clean by water blasting, or abrasive blast cleaning as appropriate until the specified degree of cleanliness is restored.
- B. Water jetting or water blasting:
1. Use water jetting or water blasting for recoating or relining where an adequate surface profile exists.
 2. Perform water jetting or water blasting in accordance with SP 13 and SSPC-WJ-1, WJ-2, WJ-3, WJ-4.

3.06 PREPARATION REQUIREMENTS FOR CONCRETE SURFACES

- A. Cure for at least 28 days before coating.
- B. Remove degraded concrete using abrasive blast cleaning or high or ultrahigh pressure water jetting, chipping, or other abrading tools until achieving a sound, clean substrate. Remove all bruised or cracked concrete.
- C. Prepare substrate cracks and areas requiring resurfacing; perform detail treatment, including, but not limited to, terminating edges per the CSM's recommendations and as indicated on the Drawings:
1. Prepare concrete surfaces in accordance with SSPC-SP 13.
- D. Prepare concrete surfaces in accordance with SSPC-SP 13:
1. Inspect concrete surfaces to select appropriate surface preparation method to provide a suitable substrate for the specified coating system.
 2. Use blast cleaning or other means to expose the complete perimeter of air voids or bug holes. Do not leave shelled over, hidden air voids beneath the exposed concrete surface.
 3. Repair concrete defects and physical damage.
 4. Clean concrete surfaces of dust, mortar, formwork, fins, loose concrete particles, form release materials, oil, and grease.
- E. Provide clean substrate visually free of calcium sulfate, loose, coarse, or fine aggregate, laitance, loose hydrated cement paste, and otherwise harmful substances:
1. Confirm concrete surface minimum pH of 9.0 with surface pH testing.
 2. If after surface preparation the surface pH remains below 9.0, perform additional water blasting, cleaning, or abrasive blast cleaning until additional pH testing indicates an acceptable pH level.
- F. Prepare concrete surface for coating in accordance with SSPC-SP 13:
1. Provide ICRI 310.2 minimum No. 3 concrete surface profile (CSP) or as specified on Coating Detail Sheets.
 2. Evaluate profile of the prepared concrete using ICRI 310.2 surface profile replicas.
- G. Blast clean cementitious repair mortars or grouts to the same profile and degree of cleanliness requirements required for concrete substrates.

- H. Blast clean polymer-based surfacers or waterborne modified cementitious surfaces only if they have exceeded the CSM's recommended recoat time.
- I. Vacuum all concrete surfaces before coating application, leaving a dust free, sound concrete substrate:
 - 1. Thoroughly clean concrete surfaces to be coated to remove loose dirt and spent abrasive.
 - 2. Remove debris produced by blast cleaning from the structures to be coated, and legally dispose of it off-site.
- J. Test moisture content of concrete to be coated:
 - 1. Conduct ASTM D4263 plastic sheet test at least once for every 500 square feet of surface area to be coated:
 - a. Any moisture on plastic sheet after test period constitutes a non-acceptable test, and the concrete must be dried further.
 - 2. Conduct ASTM F1869 test at least once for every 1,000 square feet of concrete floor surface area to be coated.
 - 3. Conduct ASTM F2170 one relative humidity moisture test at least once for each 500 square feet of non-floor concrete surface area where the opposite side is exposed to soil or water.
 - 4. Comply with specified minimum moisture content and CSM's written recommendations for moisture vapor transmission rates or relative humidity values.
- K. Masonry surfaces:
 - 1. Cure for at least 28 days before coating.
 - 2. Prepare masonry surfaces to remove chalk, laitance, loose dirt, dried mortar splatter, dust, peeling, or loose existing coatings, or otherwise deleterious substances to leave a clean, sound substrate.
 - 3. Wash and scrub masonry surfaces with clear water. Do not use muriatic acid.
 - 4. Seal or fill masonry surfaces with a sealer or block filler compatible with the specified primer after cleaning.
 - 5. Confirm that masonry surfaces are dry before coating application:
 - a. If using pressure washing or low-pressure water blast cleaning for preparation, allow the masonry to dry for at least 5 days under dry weather conditions or until the minimum ambient temperature is 70 degrees Fahrenheit before coating.

3.07 GENERAL PREPARATION REQUIREMENTS FOR METALLIC SURFACES

- A. Remove rust, scale, and welding slag and spatter.
 - 1. Remove and grind smooth all excessive weld material and weld spatter on metal surfaces before blast cleaning in accordance with NACE SP0178, Appendix C, Level C.
 - 2. Grind sharp edges on metal substrate to approximately 1/16-inch radius before abrasive blast cleaning.
- B. Prepare metallic surfaces in accordance with applicable portions of surface preparation specifications of the SSPC specified for each coating system:
 - 1. Remove grease and oil in accordance with SSPC-SP 1.
 - 2. Use solvent as recommended by the CSM.

3. Measure profile depth of the surface to be coated in accordance with Method C of ASTM D4417. Contractor shall select blast particle size and gradation to produce the specified surface profile.
 4. Constantly monitor and maintain ambient environmental conditions to ensure cleanliness and that no "rust back" occurs before coating material application.
- C. Prepare metallic surfaces by blast cleaning in accordance with SSPC-VIS 1 (ASTM D2200). Prepare abrasive blast representative areas for the Owner's representative to inspect on the first day of cleaning.
- D. Unless otherwise specified, the requirements for blast cleaning steel, ductile iron, and stainless steel substrates are as follows:
1. Ferrous metal surfaces not to be submerged: Abrasive blast in accordance with SSPC-SP 10 unless blasting may damage adjacent surfaces, is prohibited, or is specified otherwise. Where abrasive blasting is not possible, clean surfaces to bare metal with power tools in accordance with SSPC-SP 11.
 2. Ferrous metal surfaces to be submerged: Abrasive blast in accordance with SSPC-SP 5, unless specified otherwise, to clean and provide roughened surface profile with a depth between 2 and 4 mils.
 3. Remove traces of grit, dust, dirt, rust scale, friable material, loose corrosion products, or embedded abrasive from substrate before coating application.
 4. When abrasive blasted surfaces rust or discolor before coating, abrasive blast clean surfaces again.
- E. Field preparation of shop-primed surfaces:
1. Smooth welds and prominences with power tools before applying field-applied coatings.
 2. Clean and dry shop-primed ferrous metal surfaces and fabricated assemblies before applying field coats.
 3. Prepare shop epoxy primed surfaces with light abrasive blasting or abrading and then vacuum before applying finish coats:
 - a. Follow CSM instructions for surface preparation when the primer recoat limit has been exceeded.
 4. Non-immersion service: Clean in accordance with SSPC-SP 2 (Hand Tool Cleaning) or SSPC-SP 3 (Power Tool Cleaning) and uniformly roughen.
 5. Immersion, BSC, and SC service: Remove shop primer in accordance with SSPC-SP 5 (Near-White Blast Cleaning).
- F. Damaged shop primer or rust bleeding:
1. Ferrous metals: Clean in accordance with SSPC-SP 1 (Solvent Cleaning) and spot blast in accordance with SSPC-SP 10 (Near-White Metal Blast Cleaning) to achieve a uniform surface profile between 2.0 and 2.5 mils before recoating.
 2. Reject galvanized steel with rust bleeding.
- G. Damaged coating: Repair by abrasive blast cleaning surfaces as specified for the coating system; feather to a smooth transition before touching up.

3.08 PREPARATION REQUIREMENTS BY SURFACE TYPE

- A. Galvanized steel and non-ferrous metal surfaces:
1. Degrease or solvent clean (SSPC-SP 1) to remove oily residue.

2. Abrasive blast clean in accordance with SSPC-SP 16:
 - a. If abrasive blast cannot be performed, abrade in accordance with SSPC-SP 3 (Power Tool Cleaning).
 3. Apply metal pretreatment within 24 hours before coating galvanized surfaces that cannot be thoroughly abraded, such as bolts, nuts, or preformed channels.
 4. Test surface for contaminants using copper sulfate solution.
- B. Ductile iron pipe and fittings to be lined or coated: Abrasive blast clean in accordance with NAPF 500-03.
- C. Cadmium-plated, zinc-plated, or sherardized fasteners:
 1. Abrasive blast in the same manner as uncoated metal when assembling equipment designated for abrasive blasting.
- D. PVC surfaces:
 1. Lightly sand surfaces to be coated:
 - a. Sand to remove gloss and establish uniform surface profile.
 2. Vacuum to remove loose dust, dirt, and other materials.
 3. Solvent clean with clean white rags and allow solvent to evaporate completely before applying coating materials.

3.09 APPLICATION REQUIREMENTS

- A. Apply coatings in accordance with manufacturer's instructions.
- B. Empty aboveground piping to be coated of contents when applying coatings.
- C. Mechanical equipment shop primed by the manufacturer:
 1. Pumps and valves: Shop coat with manufacturer's highest quality coating system meeting the project specifications:
 - a. Contractor shall provide CTR shop coating reports.
 2. Non-immersed equipment: Touch up shop primer, and coat in the field with specified coating system after installation:
 - a. If project requires equipment removal and reinstallation, complete touch-up coating after final installation.
 3. Immersed equipment not shop-coated: Remove shop primer before surface preparation and field apply coating.
- D. Verify surface preparation immediately before applying coating in accordance with SSPC SP COM and the SSPC visual standard for the specified surface preparation method.
- E. Allow surfaces to dry, except where coating manufacturer requires surface wetting before coating.
- F. Wash coat and prime sherardized, aluminum, copper, and bronze surfaces, or prime with manufacturer's recommended special primer.
- G. Do not apply coatings to a surface until it has been prepared as specified.

- H. Use equipment designed to apply materials specified:
 - 1. Use compressors with moisture traps and filters that remove water and oils from the air:
 - a. Perform a paper blotter test at the Engineer's request to verify air is sufficiently free of oil and moisture. Do not allow the amount of oil and moisture to exceed CSM-recommended amount.
 - 2. Equip spray equipment with properly sized mechanical agitators, pressure gauges, pressure regulators, and spray nozzles.
- I. Where 2 or more coats are required, tint prime coat intermediate coats as necessary to distinguish each coating and to help indicate coverage:
 - 1. Do not use color additives with chromium, lead or lead compounds that hydrogen sulfide, other corrosive gases, might destroy or alter. Apply the specified number of coats.
- J. Apply coating by brush, roller, trowel, or spray unless a specific application method is required by coating manufacturer's instructions or these Specifications:
 - 1. Apply primer or first coat by brush to power tool cleaned ferrous surfaces.
 - 2. Brush or spray-apply coats for blast-cleaned ferrous surfaces and subsequent coats for non-blast cleaned ferrous surfaces.
 - 3. After prime coat dries, mark, repair, and retest pinholes and holidays before intermediate or top coats are applied.
- K. Spray application:
 - 1. With a brush, stripe coat edges, welds, corners, nuts, bolts, and difficult-to-reach areas, as necessary, before spray application to ensure specified coating thickness along edges.
 - 2. When using spray application, apply each coat to thickness no greater than recommended in coating manufacturer's instructions.
 - 3. Use airless spray method unless air spray method is required by CSM's instruction or these Specifications.
 - 4. Conduct spray coating under controlled conditions. Protect adjacent construction and property from coating mist, fumes, or overspray.
- L. Lightly sand and thoroughly clean surfaces to receive high-gloss finishes unless CSM instructs otherwise.
- M. Remove all dust on coatings between coats.
- N. Shop and field coats:
 - 1. Prime coat: Shop-apply or field-apply prime coats as specified. Use shop-applied primer compatible with the specified field coating system and apply at the minimum dry film thickness recommended by the finish coat CSM:
 - a. Provide data sheets identifying the shop primer to on-site coating application personnel.
 - b. Perform adhesion tests on the shop primer.
 - c. Remove and recoat damaged, deteriorated, and poorly applied shop coatings.
 - d. If shop primer coat meets this Section's requirements, spot prime exposed metal of shop-primed surfaces before spray applying primer over the entire surface.

2. Field coats: Apply field coats with 1 or more prime coats and finish coats to build up coating to dry film thickness specified for the coating system:
 - a. Do not apply finish coats until other work in the area is complete and previous coats are inspected.
 3. Adhesion confirmation: Perform adhesion tests after proper coating cure in accordance with ASTM D3359. Demonstrate that:
 - a. Prime coat adheres to the substrate.
 - b. Coatings adhere to the prime and intermediate coats:
 - 1) Coating 5 mils or more DFT: Achieve adhesion test result of 5A on immersed surfaces and 4A or better on other surfaces.
 - 2) Coating less than 5 mils DFT: Achieve adhesion test results of 5B on immersed surfaces and 4B or better on other surfaces.
- O. Brush, roll, trowel, or spray and back roll coats for concrete and masonry.
- P. Plural component coating application:
1. Premix contents of component drums if required by the CSM each day.
 2. Before starting application:
 - a. Verify gauges are working properly.
 - b. Complete ratio checks.
 - c. Sample the mix on plastic sheeting to ensure set time is appropriate and complete.
 - d. Label and retain all spray samples. Submit to Engineer when requested.
- Q. Drying and recoating:
1. Provide fans, heating devices, or other means to prevent condensate or dew on substrate surface or between coats and during curing after applying the last coat.
 2. Allow each coat to cure or dry thoroughly, in accordance with if required in CSM's printed instructions, before recoating.
 3. Use CSM's printed instructions and the requirements specified in this Section to determine minimum required drying time:
 - a. Do not allow excessive drying time or exposure, which may impair bond between coats.
 - b. Recoat all coatings within time limits recommended by CSM.
 - c. If time limits are exceeded, abrasive blast clean and de-gloss clean before applying another coat.
 4. If limitations on time between abrasive blasting and coating are not met before attaching components to surfaces that cannot be abrasive blasted, coat components before attachment.
 5. Ensure primer and intermediate coats of coating are unscarred and completely integral when applying each succeeding coat.
 6. Touch up suction spots between coats and apply additional coats where required to produce finished surface of solid, even color, free of defects.
 7. Leave no holidays. Repair all holidays in accordance with the requirements on pertinent Coating Detail Sheets or as recommended by the CSM.
 8. Sand and feather in to a smooth transition and recoat scratched, contaminated, or otherwise damaged coating surfaces so repairs are invisible to the naked eye.

- R. Workmanship:
1. Ensure that coated surfaces are free from runs, drips, ridges, waves, laps, and brush marks. Coats shall be applied to produce a smooth, even film of uniform thickness completely coating corners and crevices.
 2. Coat surfaces without drops, overspray, dry spray, excessive runs, ridges, waves, holidays, laps, or brush marks.
 3. Remove splatter and droppings after coating work is completed.
 4. Evenly apply each coat of material and sharply cut to a line created with masking tape or other suitable materials.
 5. Avoid over spraying or spattering paint on surfaces not to be coated. Protect glass, hardware, floors, roofs, vehicles, and other adjacent areas and installations by taping, drop cloths, or other suitable measures.
 6. When coating complex steel shapes, stripe coat welds, edges of structural steel shapes, metal cut-outs, pits in steel surfaces, or rough surfaces with the primer before overall coating system application:
 - a. Brush apply stripe coat to ensure proper coverage.
 - b. Do not stripe coat with spray or roller.
 7. Ensure that finish coat, including repairs, has a uniform color and gloss.
- S. Coating properties, mixing, and thinning:
1. Thin prime coat and apply as recommended by the CSM. Thinned coating must comply with prevailing air pollution control regulations.
 2. If maximum recoat time is exceeded, prepare surface with solvent washing, light abrasive blasting, or other procedures per CSM's instructions.
 3. Allow adequate drying time between coats as instructed by the CSM, adjusted as necessary for the site conditions.
 4. Ensure that coatings, when applied, provide a satisfactory film and a smooth even surface. Lightly sand glossy undercoats to provide a surface suitable for proper application and adhesion of subsequent coats. Thoroughly stir and strain coating materials during application and maintain uniform consistency.
 5. Mix coatings with 2 or more components in accordance with CSM's instructions.
 6. Where necessary to suit conditions of the surface, temperature, weather and method of application, thin the coating per CSM's recommendations:
 - a. Ensure that volatile organic content (VOC) of the thinned coating complies with prevailing air pollution control regulations.
 - b. Thin coatings to only what is necessary to obtain proper application characteristics.
 - c. Use a thinner recommended by the CSM.
- T. Film thickness and continuity:
1. Apply coating to the specified thicknesses:
 - a. Apply additional coats when necessary to achieve specified thicknesses, especially at edges and corners.
 2. Verify WFT of the coating system first coat and after applying each subsequent coat.
 3. Do not allow the minimum thickness at any point to deviate more than 25 percent from the required average.
 4. Do not allow the surface area covered per gallon of coating for various types of surfaces to exceed those recommended by the CSM:
 - a. Provide coating coverage worksheets listing the maximum and minimum coverage for each unit volume of coating for concrete surfaces.

5. Apply additional coats to achieve the specified dry film thickness if brush or roller application methods cannot achieve the specified film thicknesses per coat.
- U. Protecting coated surfaces:
1. Do not handle, work on, or otherwise disturb coated items until the coating is completely dry and hard.
 2. After installation, recoat shop-coated surfaces with specified coating system as necessary to match surrounding surfaces, and to coordinate with the specified color identification requirements.
- V. Special requirements:
1. Before erection, apply all but the final finish coat to interior surfaces of roof plates, roof rafters and supports, pipe hangers, piping in contact with hangers, and contact surfaces inaccessible after assembly. Apply final coat after erection.
 2. Coat structural slip-critical connections and high strength bolts and nuts after erection.
 3. Areas damaged during erection:
 - a. Prepare surface for spot repairs as specified for the coating system.
 - b. Recoat with prime coat before applying subsequent coats.
 - c. Touch up surfaces after installation.
 - d. Clean and dry surfaces to be coated at time of application.
 4. Coat underside of equipment bases and supports not galvanized with at least 2 coats of primer specified before setting the equipment in place.
 5. Coat aluminum in contact with concrete.

3.10 APPLICATION REQUIREMENTS FOR CONCRETE COATING SYSTEMS

- A. Apply filler/surfacer as recommended by CSM to fill bug holes and air voids in concrete or block texture in CMU, leaving a uniformly filled surface that does not produce blowholes or outgassing causing the coating system to pinhole:
1. Allow filler/surfacers to cure sufficiently before applying prime coat as required by the CSM. Use the CSM-recommended drying time between coats.
- B. Apply surfacer or filler and let dry before coating application:
1. Use the drying time between filler/surfacer and coating system specified by the CSM for the site conditions:
 - a. Let concrete substrate dry before applying filler/surfacers or coating system materials.
 2. If the maximum recoat time is exceeded, prepare surfaces by solvent washing, light abrasive blasting, and other procedures per CSM's instructions.
 3. Apply a complete parge coat of the specified filler/surfacer material over the entire substrate before applying the coating system:
 - a. Scrub filler/surfacer into the substrate to completely fill open air voids and bug holes.
 - b. Completely cover the substrate, unless otherwise specified, above such filled voids by 1/8 inch of thickness.
 - c. Provide relatively flat, uniformly even surface before coating application.

4. Secondary containment: Place surfacer or filler 1/16 inch thick above concrete plane to create a monolithic surface free of pinholes:
 - a. Floor surfaces: Broadcast with aggregate to create a non-slip surface texture.
 - b. Remove excess aggregates and apply base coat to encapsulate embedded non-slip aggregate.
- C. Concrete substrate temperatures:
 1. Apply filler/surfacers and the coating system when temperatures are falling, typically late afternoon or evening:
 - a. Do not coat concrete with rising concrete substrate surface temperatures or substrates in direct sunlight, to minimize outgassing from the substrate and formation of pinholes, and/or blistering.
 2. Should bubbles, pinholes, or other discontinuities form in the applied coating system material, they shall be repaired:
 - a. Should discontinuities develop in the filler/surfacer material or in the first coat of the coating material, repair them before the next coat.
 - b. When discontinuities occur, open the air void behind or beneath the discontinuities and completely fill with specified coating material. Then, abrade the coated area around the discontinuities repair reapply coating over that area.
- D. Perform application detail work in accordance with these Specifications, the CSM's current written recommendations, and drawings, whichever is stricter.
- E. Concrete coating systems application requirements:
 1. Concrete coating minimum dry film thickness excludes parge coat, block filler, and sealer.

3.11 COATING SYSTEM SCHEDULE

- A. Appendix A specifies surfaces to be coated in the field with the coating systems required.

3.12 SURFACES NOT REQUIRING COATING

- A. Stainless steel piping, valves, pipe supports, instrument sunshades.
- B. Sliding surfaces on expansion joints, motor and pump shafts, machined surfaces at bearings and seals, grease fittings, etc.
- C. Galvanized structural steel framing, galvanized roof decking, galvanized pipe supports.
- D. Copper and brass pipe, fittings, valves, etc.
- E. Bronze valves, bearings, bushings, and fasteners.
- F. Corrosion resistant special alloys: Inconel, Alloy 20, Hastelloy, etc.
- G. Exterior Concrete.

- H. Plastic surfaces except coat PVC, CPVC, and other plastic piping system exposed to sunlight or as specified.
- I. Buried Piping that is encased in concrete or cement mortar.

3.13 QUALITY CONTROL

- A. Owner-provided inspection or inspection by others does not limit the Contractor's or CSA's responsibilities for quality workmanship or quality control as specified or as required by the CSM's instructions. Owner inspection is in addition to any inspection required of the Contractor.
- B. Owner may perform, or contract with an inspection agency to perform, quality control inspection and testing of the coating work covered by this Section. These inspections may include the following:
 - 1. Inspect materials upon receipt to ensure that the CSM supplied them.
 - 2. Verify that specified storage conditions for the coating system materials, solvents, and abrasives are provided.
 - 3. Inspect and record findings for substrate cleanliness.
 - 4. Inspect and record pH of concrete and metal substrates.
 - 5. Inspect and record substrate profile (anchor pattern).
 - 6. Measure and record ambient air and substrate temperature.
 - 7. Measure and record relative humidity.
 - 8. Check for substrate moisture in concrete.
 - 9. Verify that mixing of coating system materials is in accordance with CSM's instructions.
 - 10. Inspect, confirm, and record that coating system materials' "pot life" is not exceeded during installation. Inspect to verify that recoat limitations for coating materials are not exceeded.
 - 11. Perform adhesion testing.
 - 12. Measure and record the coating system's thickness.
 - 13. Verify proper curing of the coating system in accordance with the CSM's instructions.
 - 14. Holiday or continuity testing in accordance with NACE SP0188 for coatings that will be immersed or exposed to aggressively corrosive conditions.
- C. Contractor shall perform holiday testing in accordance with NACE SP0188 to identify holidays or pinholes needing repair for coating over 100 percent of surfaces:
 - 1. Coated steel that will be immersed or exposed to aggressively corrosive conditions.
 - 2. Coated concrete.
 - 3. Perform holiday tests after proper application and coating system cure.

3.14 CORRECTIVE MEASURES

- A. Repair pinholes or holidays identified by Holiday Testing as follows:
 - 1. Remove the coating system with a grinder or other suitable power tool.
 - 2. Remove coating system at all pinholes and holidays at least 2 inches diameter around the defect back to expose substrate.
 - 3. Concrete voids: chip back to expose entire cavity in all directions:
 - a. Completely fill void with approved filler/surfacer material using a putty knife or other suitable tool, and strike off. Cure per CSM's recommendations.

4. Aggressively abrade or sand the intact coating system surface at least 3 inches beyond the removal area in all directions to produce a uniform 6- to 8-mil profile in the intact coating system.
5. Vacuum the prepared area to remove all dust, dirt, etc., leaving clean, sound surfaces.
6. Tape to mask the periphery of the prepared intact coating area to prevent coating repair application onto the prepared area.
7. Apply the coating system with enough coats to achieve the specified finish coat thickness over the defect and coating removal area. Feather the coating onto the abraded coated surfaces around the removal area to avoid a lip and to achieve a neat repair outline.
8. Follow curing time between coats as specified by CSM for the site conditions. Solvent wash and abrasive blast per CSM's instructions, if the maximum recoat time is exceeded.
9. Apply coating at specified dry film thickness.

3.15 CLEANUP

- A. Remove surplus materials, protective coverings, and accumulated rubbish after completing coating. Thoroughly clean surfaces and repair overspray or other coating-related damage.

3.16 FINAL INSPECTION

- A. Conduct final inspection of coating system work to determine whether it meets specifications requirements.
- B. Conduct subsequent final inspection with Engineer to ensure work conforms to contract documents requirements.
- C. Mark any rework required:
 1. Re-clean and repair, as specified, at no additional cost to the Owner.

END OF SECTION

APPENDIX A
Schedule of Surfaces to be Coated

A. The following schedule is incomplete. Coat unlisted surfaces with same coating system as similar listed surfaces. Contact Engineer for clarification.

EPU-M-1	Metals, exterior, non-immersed	
EPX-M-2-PWS	Metals: immersed and in contact with water being treated for domestic use (potable water).	
EPX-M-6-BG		0
VE-C-1		0
ACR-PVC-1		0

Notes:

1: Non-immersed ferrous metal surfaces include:

- a. Doors, doorframes, ventilators, louvers, grilles, exposed sheet metal, and flashing.
- b. Pipe, valves, pipe hangers, supports and saddles, conduit, cable tray hangers, and supports.
- c. Motors and motor accessory equipment.
- d. Drive gear, drive housing, coupling housings, and miscellaneous gear drive equipment.
- e. Valve and gate operators and stands.
- f. Structural steel.
- g. Crane and hoist rails.
- h. Exterior of tanks and other containment vessels.
- i. Mechanical equipment supports, drive units, and accessories.
- j. Bare electrical equipment: boxes, exposed conduit, and accessories.
- k. Pumps not submerged.
- l. Other miscellaneous metals.

2: Immersed ferrous metal surfaces include:

- a. Interior surfaces of ferrous metal tanks.
- b. Field priming of ferrous metal surfaces with defective shop-prime coat; including non-submerged service.
- c. Bell rings, underside of manhole covers and frames.
- d. Sump pumps, including underside of base plates and submerged suction and discharge piping.
- e. Exterior of submerged piping and valves other than stainless steel or PVC piping.
- f. Submerged pipe supports and hangers.
- g. Stem guides.
- h. Other submerged iron and steel metal unless specified otherwise.

Appendix B
Coating Detail Sheet

Appendix B			
Coating Detail Sheet			
Coating System	EPU-M-1		
Coating Material	Two coats epoxy with polyurethane finish coat		
Substrate	Metal		
Products	Primer	Intermediate Coat	Finish Coat
Carboline	Carboguard 890	Carboguard 890	Carbothane 134 VOC
International Paint	Devran 224V	Devran 224V	Devthane 379
PPG	Amercoat 385	Amercoat 385	Amercoat 450H
Sherwin Williams	Macropoxy 646	Macropoxy 646	Hi Solids Polyurethane
Tnemec	Series 66HS	Series 66HS	Series 1095
Service Condition	Interior or Exterior, subject to direct sunlight. Non-immersion.		
Surface Preparation			
General	Prepare surfaces as specified in this Section and as follows.		
Ferrous Metal	Bare surfaces: SSPC-SP10, Near-White Blast Cleaning. Shop primed surfaces: SSPC-SP2, Hand Tool Cleaning or SSPC-SP3, Power Tool Cleaning. Damaged primer or rust: SSPC-SP10, Near White Blast Cleaning and spot prime.		
Nonferrous Metal	SSPC-SP16, Brush Blast Cleaning.		
Galvanized Metal	SSPC-SP16, Brush Blast Cleaning. Test for surface contaminants.		
Surface profile			
Ferrous Metal	2.5 to 3.0 mils		
Nonferrous Metal	1.5 to 2.0 mils		
Galvanized Metal	1.5 to 2.0 mils		
System Thickness (Dry Film)			
Total	10 to 13 mils		
Primer	4 to 5 mils		
Intermediate Coat	4 to 5 mils		
Finish Coat	2 to 3 mils		
Application			
Special CTR Training	Not required.		

Appendix B
Coating Detail Sheet

Appendix B			
Coating Detail Sheet			
Coating System	EPX-M-2-PWS		
Coating Material	Ultra-high Solids Epoxy		
Substrate	Metal		
Products	Primer	Intermediate Coat	Finish Coat
Carboline	Plasite 4500	None Applied	Plasite 4500
International Paint	No product specified	No product specified	No product specified
PPG	No product specified	No product specified	No product specified
Sherwin Williams	Sher-Plate	None Applied	Sher-Plate
Tnemec	Series 22	None Applied	Series 22
Service Condition	Immersed, moderately corrosive environment in contact with Potable Water.		
Surface Preparation			
General	Prepare surfaces as specified in this Section and as follows.		
Ferrous Metal	Bare surfaces: SSPC-SP5, White Metal Blast Cleaning. Shop primed surfaces: SSPC-SP7, Brush-Off Blast Cleaning. Damaged primer or rust: SSPC-SP5, White Metal Blast Cleaning and spot prime.		
Surface profile			
Ferrous Metal	2.0 to 2.5 mils		
Primed surfaces	1.0 to 1.5 mils on the intact primer.		
System Thickness (Dry Film)			
Total	16 to 25 mils		
Application			
Special CTR Training	Required.		

Appendix B
Coating Detail Sheet

Appendix B			
Coating Detail Sheet			
Coating System	EPX-M-6-BG		
Coating Material	Epoxy		
Substrate	Metal		
Products	Primer	Intermediate Coat	Finish Coat
Carboline	Carboguard 890	Carboguard 890	Carboguard 890
International Paint	Bar-Rust 236	Bar-Rust 236	Bar-Rust 236
PPG	Amerlock 2/400 Series	Amerlock 2/400 Series	Amerlock 2/400 Series
Sherwin Williams	Macropoxy 80	Macropoxy 80	Macropoxy 80
Tnemec	Series 66HS	Series 66HS	Series 66HS
Service Condition	Below grade in contact with soil.		
Surface Preparation	Prepare surfaces as specified in this Section and as follows.		
General	Prepare surfaces as specified in this Section and as follows.		
Ferrous Metal	SSPC-SP10, Near White Metal Blast Cleaning.		
Nonferrous Metal	SSPC-SP16, Brush-Off Blast Cleaning.		
Galvanized Metal	SSPC-SP16, Brush-Off Blast Cleaning.		
Surface profile			
Ferrous Metal	2.5 to 3.0 mils		
Nonferrous Metal	1.5 to 2.0 mils		
Galvanized Metal	1.5 to 2.0 mils		
System Thickness (Dry Film)			
Total	16 mils		
Primer	4 to 6 mils		
Intermediate Coat	4 to 6 mils		
Finish Coat	4 to 6 mils		
Application			
General	Fill all bugholes with a filler/surfacer compatible with the coating.		
Special CTR Training	Not Required.		

Appendix B
Coating Detail Sheet

Coating System	VE-C-1		
Coating Material	Vinyl Ester		
Substrate	Concrete		
Products	Primer	Intermediate Coat	Finish Coat
International Paint			Celcote Flakeline 232.
PPG			Nova Rez 370
Sherwin Williams			CorCote VEN
Tnemec			Series 120-5001 Vinester
Service Condition	Immersed, non-immersed, very corrosive environment, color not required, new or existing construction. Primary or secondary containment indoors or exterior.		
General	Prepare surfaces as specified in this Section and as follows.		
Concrete	<p>Apply complete parge coat over all concrete surfaces after surface preparation is accepted. Completely fill all bugholes with the same material. Brush blast clean, if parge coat is non-polymer modified, after adequate cure per CSM's instructions to produce a uniform anchor pattern.</p> <p>Let concrete substrate cure under warm conditions (minimum of 75 degrees F) for at least 5 days before coating application if using wet abrasive or water jet surface preparation.</p> <p>Sawcut 1/4" minimum deep groove and provide coating termination and transition details as shown on the drawings and in accordance with CSM's standard details including terminations, transitions at corners, cracks, pipe penetrations, terminations at metal embedments, and other details.</p> <p>Vacuum all surfaces to be coated after surface preparation and curing to remove all loose dirt, dust, or other loose materials.</p>		
Existing Coated Concrete	Prepare as for new concrete. Apply a skim coat of a surfacer or filler material to restore the substrate to a coatable condition.		
Surface profile			
Concrete	ICRI CSP 5.		
Existing Coated Concrete	ICRI CSP 5.		
System Thickness (Dry Film)			
Parge coat	Completely cover the substrate above filled voids by 1/8 inch (125 mils) of thickness.		
Total	60 to 65 mils in addition to the parge coat.		
Primer	Per CSM's recommendations.		
Intermediate Coat			
Finish Coat			
Application			
General	Trowel-apply surfacers or filler materials CSM's recommendations. Work surfacer/filler into all voids to displace air and fill bugholes.		
Special CTR Training	Required.		

Appendix B
Coating Detail Sheet

Coating System	ACR-PVC-1		
Coating Material	Acrylic		
Substrate	PVC and CPVC pipe		
Products	Primer	Intermediate Coat	Finish Coat
Carboline	Carbocrylic 120	None Applied	Carbocrylic 3359
International Paint	Devcryl 1440	None Applied	Devcryl 1448
PPG	Pitt Tech Primer	None Applied	Pitt Tech
Sherwin Williams	Sher Cryl HPA	None Applied	Sher Cryl HPA
Tnemec	Series 1028 or 1029	None Applied	Series 1028 or 1029
Service Condition	Exterior, exposed to direct sunlight, non-immersed.		
Surface Preparation	Prepare surfaces as specified in this Section and as follows.		
General	Clean to remove loose dirt, dust, or other contaminants. Sand surfaces to achieve a uniform, roughened surface profile. Solvent clean and vacuum to remove loose debris.		
Surface profile	1.5 to 2.0 mils		
System Thickness (Dry Film)			
Total	4 to 8 mils		
Primer	2 to 4 mils		
Finish Coat	2 to 4 mils		
Application			
Special CTR Training	Not Required.		

SECTION 10_14_00

SIGNAGE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Plastic and metal signs for building and site use.

1.02 REFERENCES

- A. National Fire Protection Association (NFPA):
 - 1. 704 - Standard System for the Identification of the Hazards of Materials for Emergency Response.
- B. Occupational Safety and Health Administration (OSHA).

1.03 SUBMITTALS

- A. Product data.
- B. Shop drawings: Include lists of sign types, sizes, text, and colors; mounting details; locations; and cast metal plaque rubbings and templates.
- C. Samples: Include actual materials.
- D. Manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. Manufacturer qualifications: Manufacturer of proposed products for minimum 5 years with satisfactory performance record of minimum 5 years.
- B. Installer qualifications: Manufacturer approved installer of products similar to specified products on minimum 10 projects of similar scope as Project with satisfactory performance record.
- C. Regulatory requirements: Provide signage in accordance with Americans with Disabilities Act as published in the Federal Register, Volume 56, No. 144, Friday, July 26, 1991.

PART 2 PRODUCTS

2.01 HAZARD MATERIAL SIGNALS

- A. Manufacturer: One of the following or equal:
 - 1. Seton Name Plate Co.
 - 2. Emedco.

- B. Hazard material signals: In accordance with NFPA 704; vinyl panels, letters, and symbols with pressure sensitive adhesive, sizes as required for viewing distances, letters and symbols in accordance with Schedule A.

PART 3 EXECUTION

3.01 PREPARATION

- A. Protect adjacent surfaces which may be damaged by installation of signs.
- B. Prepare substrates in accordance with sign manufacturer's instructions.
- C. Remove scale, dirt, grease, and other contaminants from substrates.

3.02 INSTALLATION

- A. Install signs in accordance with sign manufacturer's instructions.
- B. Fasten signs securely in level, plumb, and true to plane positions.
- C. Install signs where indicated on the Drawings.

END OF SECTION

SCHEDULE A

HAZARD MATERIAL SIGNALS

A. HAZARD SIGNAL FOR SODIUM HYPOCHLORITE 0.8 PERCENT:

1. Location: At entrances to locations where stored and on storage tanks.
2. Health: 1.
3. Flammability: 0.
4. Reactivity: 1.
5. Special: COR.

END OF SCHEDULE A

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SECTION 21_11_17

FIRE HYDRANTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Barrel type fire hydrants.

1.02 REFERENCES

- A. American Water Works Association (AWWA):
 1. C 502 - Standard for Dry-Barrel Fire Hydrants.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. One of the following or equal:
 1. Mueller Co., Super Centurion.

2.02 MATERIALS

- A. Fire hydrants:
 1. Dry barrel in accordance with type AWWA C 502, as complemented and modified in this Section.
 2. Provide hydrants with ground level break-off feature and manufactured such that the valve stem will not be bent when the hydrant is damaged or broken at or near the ground level.
 3. When shut, provide valves that remain reasonably tight when the upper portion of the barrel is broken off.
 4. Diameter of the main valve opening: Nominal 5-1/4 inch compression type.
 5. Inlet connection: 6-inch diameter mechanical joint for ductile iron pipe.
 6. Provide two 2-1/2-inch hose nozzles with American National Standard threads and one 4-1/2-inch pumper port, Storz Seattle style thread, model number HPHA 40-40-004/CAP, size 4.875-inch by 6-inch facing the street:
 - a. Provide nozzles with hose caps chained to the hydrant barrel.
 7. Operating nut shall be 1-1/2-inch National Standard Pentagon nut.
 8. The main valve shall be equipped with O-ring seals and shall open when turned counterclockwise
 9. Color of hydrant shall be selected by the Owner during submittal review.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation of hydrants shall conform to the provisions of AWWA C600. Locate hydrants to provide complete accessibility and to minimize the possibility of damage

from vehicles or injury to pedestrians. A minimum 3 foot radius unobstructed working area shall be provided around all hydrants.

- B. Set hydrants plumb and nozzles parallel with, or at right angles, to the curb or roadway, with the pumper nozzle facing the curb or roadway. Set hydrant so that the safety flange is 2 inches above finished grade and bolts can be removed.
- C. If the hydrant lead is longer than one full length of pipe Field Lok gaskets shall be used.
- D. Place concrete block on firm, level sub-base to assure uniform support. Carefully place hydrant on base block to prevent the base block from breaking. Jointing procedures shall conform to AWWA C600. Strapping lugs shall not be used. After hydrant is in place and connected to the pipeline, place temporary blocks to maintain the hydrant in a plumb position during subsequent work.
- E. Place 1-1/2-inch washed rock and filter fabric around base block and hydrant bottom after hydrant has been blocked in place. Top of the washed rock shall not be less than 6 inches above hydrant drain opening.
- F. After all installation and testing is complete, the exposed portion of the hydrant shall be thoroughly cleaned and painted with two coats of Farwest #250 high gloss white paint per City of Mercer Island Std. Detail W-24.

3.02 REMOVING EXISTING HYDRANTS

- A. Existing hydrants to be removed on existing water mains that will remain active shall be removed to the hydrant tee at the existing main. A water main shutdown will be required for this work. The hydrant tee shall be capped or plugged and completed with a permanent blocking. If the hydrant valve is not flanged to the existing tee connection, then the tee shall be cut out and the contractor shall install spools and sleeves in place of the removed pipe and fittings.
- B. The Contractor shall provide 3 weeks' notice to the Owner when the water main shutdown is scheduled. The Contractor is to have both 4 inch and 6 inch flanged and mechanical joint caps and plugs onsite prior to shutting down the water system.
- C. The Owner will notify affected residents in advance, conduct the shutdown and recharge the water main.
- D. In situations when existing hydrants will be removed on existing water mains scheduled to be abandoned, the hydrant assembly shall be removed and the existing pipe capped or plugged as directed by the Owner. No water main shutdown will be required for this work.

END OF SECTION

SECTION 22_42_01
PLUMBING SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements for materials and installation of plumbing systems.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME).
- B. National Electrical Manufacturers Association (NEMA):
 - 1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).
- C. Underwriters Laboratories, Inc. (UL):
 - 1. 94 - Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.03 DEFINITIONS

- A. NEMA: Type 4X enclosure in accordance with NEMA 250.

1.04 REQUIREMENTS

- A. Include in plumbing system:
 - 1. Fixtures.
 - 2. Drain, vent, and water piping.
 - 3. Connections and cleanouts.
 - 4. Fittings and accessories.
 - 5. Parts and pieces necessary to provide a complete system.
 - 6. Testing for complete and functional system.
- B. Except in typical details, piping is indicated on the Drawings in diagrammatic form. Sizes and locations are indicated on the Drawings; however, not every offset and fitting, nor every structural difficulty that will be encountered in the Work has been indicated.
- C. Modify piping alignment indicated on the Drawings as necessary to avoid structural or mechanical obstructions and to clear the work of other trades.

1.05 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Shop drawings, as applicable:
 - 1. System layout, mechanical, electrical power, and control diagrams.
 - 2. Nameplate information.
 - 3. Materials.

4. Coatings and linings.
 5. Rough-in drawings.
 6. Supports, vibration isolators, and seismic bracing calculations and details.
 7. Primary and ancillary equipment.
 8. Proposed cutting and patching.
 9. Maximum recommended equipment vibration levels and field-testing method.
 10. Copy of factory test results.
- C. Operation and maintenance data as specified in Section 01_78_24 - Operation and Maintenance Manuals.
- D. Field testing documentation.
- E. Warranties.

1.06 QUALITY ASSURANCE

- A. Work to be in accordance with the plumbing code specified in Section 01_41_00 - Regulatory Requirements, and in accordance with applicable laws and regulations, including requirements for accessibility, energy, water conservation, and health related requirements for water fountains and coolers:
1. Where provisions specified in these Specifications or indicated on the Drawings are in conflict with the plumbing code specified in Section 01_41_00 - Regulatory Requirements or laws or regulations, the Code and the laws or regulations take precedence over the specified provisions and design.

PART 2 PRODUCTS

2.01 GENERAL

- A. As specified in Section 01_60_00 - Product Requirements.

2.02 EQUIPMENT

- A. General:
1. As specified when applicable in Section 46_05_10 - Common Work Results for Mechanical Equipment.
- B. Water heaters:
1. Size and requirements as indicated on the Drawings.
 2. Provide with temperature limiting device meeting ASSE 1070.
 3. Electric water heaters:
 - a. UL listed.
 - b. Glass lined storage tank.
 - c. 2 inches minimum fiberglass insulation.
 - d. Exterior steel casing with factory standard enamel finish.
 - e. High efficiency immersion heating elements.
 - f. Automatic temperature control.
 - g. Externally adjustable setting.
 - h. ASME rated temperature and pressure relief valve.
 - i. Magnesium anode, tank cleanout.

- j. Manufacturers: One of the following or equal:
 - 1) Rheem Water Heater.
 - 2) A. O. Smith Corp.
 - 3) State Ind., Inc.
- k. Warranty:
 - 1) Special warranty:
 - a) Duration: Provide 3-year warranty.
- 4. Tepid water mixing valves for sodium hypochlorite generator:
 - a. Manufacturers: One of the following or equal:
 - 1) Powers, ES150.
 - b. General requirements:
 - 1) Thermostatic mixing valve with internal cold-water bypass system.
 - 2) Outlet temperature, min (not in bypass): 60 deg. F.
 - 3) Set outlet temperature to 70 deg. F.
- 5. Tankless electric water heaters:
 - a. Provide tankless electric water heater to serve emergency safety shower and eye wash with the following characteristics:
 - 1) Temperature rise at 20 gallons per minute: 25 deg. F minimum.
 - 2) Temperature rise at 3 gallons per minute: 25 deg. F minimum.
 - 3) Leaving water temperature shall be maintained at 80 deg. F when providing tepid water to emergency shower/eye wash stations.
 - 4) Heating coils: Ni Chrome.
 - 5) Electrical requirements:
 - a) Voltage: 480 volts.
 - b) Power: 72,000 watts.
 - c) Coordinate disconnect with electrical contractor as required.
 - 6) Maximum operating pressure of 150 psi.
 - 7) Flow switch activated:
 - a) Heating coils activate at 3 or 15 gpm.
 - 8) Provide necessary supports and anchoring required for installation as indicated on the Drawings.
 - 9) Unit shall be provided in NEMA 4X cabinet enclosure.
 - 10) Manufacturers: One of the following or equal:
 - a) Haws, Model 9327.
 - b) Eemax, similar model.
 - c) Keltech, similar model.

PART 3 EXECUTION

3.01 GENERAL

- A. As specified in Section 01_60_00 - Product Requirements.
- B. As specified in Section 40_05_06.55 - Piping Insulation.
- C. Furnish and install vents required in drainage piping as part of the plumbing system, in accordance with Laws and Regulations.
- D. Use Link Type Seals as indicated on the Drawings.

3.02 INSTALLATION

- A. Equipment:
 - 1. As specified when applicable in Section 46_05_10 - Common Work Results for Mechanical Equipment.
 - 2. Provide piping for drain and overflow connections to drains.

3.03 FIELD QUALITY CONTROL

- A. Testing:
 - 1. Test water piping with water under a pressure of 100 psig:
 - a. As required per code.
 - 2. Repair and correct defective work disclosed by testing. Repeat testing until defective work is corrected.

3.04 CLEANING AND DISINFECTION

- A. Upon completion of installation, clean piping interior of foreign matter and debris.
- B. Flush and disinfect potable water piping as specified in Section 01_75_18 - Disinfection.

3.05 SCHEDULES

- A. As indicated on the Drawings.

END OF SECTION

SECTION 22_45_17

EMERGENCY EYE/FACE WASH AND SHOWER EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Emergency shower and eyewash.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. Z358.1 - Emergency Eyewash and Shower Equipment.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).
- C. National Fire Protection Association (NFPA).
- D. Occupational Safety and Health Administration (OSHA).

1.03 DEFINITIONS

- A. NEMA:
 - 1. Type 4 enclosure in accordance with NEMA 250.

1.04 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data: As specified in Section 46_05_10 - Common Work Results for Mechanical Equipment.
- C. Shop drawings: As specified in Section 46_05_10 - Common Work Results for Mechanical Equipment.
- D. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds.

1.05 QUALITY ASSURANCE

- A. Regulatory requirements:
 - 1. As applicable, equipment of this Section shall comply with requirements of public agencies of the state where the project is located including NFPA and OSHA.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping: Deliver to the job site in manufacturer's original containers.
- B. Delivery: After wet operations in building are completed.

- C. Storage and protection:
1. Store materials in original, unopened containers in compliance with manufacturer's printed instructions.
 2. Keep materials dry until ready for use.
 3. Keep packages of material off the ground, under cover, and away from sweating walls and other damp surfaces.
 4. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with a protective covering.

PART 2 PRODUCTS

2.02 EMERGENCY SHOWERS AND EYE/FACE WASHES

- A. General design requirements:
1. Combination unit emergency shower with eye/face wash:
 - a. Floor mounted fixture consisting of pipe standard, showerhead assembly, and eyewash assembly.
 - b. Provide stanchion and floor flange, with interconnecting piping.
 2. Showerhead flow: 20.0 gallons per minute flow, minimum.
 3. Eye/face wash flow: 3.0 gallons per minute flow, minimum.
 4. Meet or exceed all requirements of ANSI Z358.1.
 5. Provide ANSI compliant identification sign and markings.
- B. Shower/eyewash unit with integral controls to alarm the system is in use:
1. Flow switch:
 - a. Construction:
 - 1) NEMA Type 4.
 - 2) Brass or Type 316 Stainless Steel.
 - b. Type: Magnetic proximity switch.
 - c. Alarm Contacts: Double pole, double throw contacts rated at 2.0 Amps at 120VAC configurable for either Normally Open or Normally Closed.
 2. Control panel:
 - a. Construction:
 - 1) NEMA Type 4.
 - 2) Cast aluminum or steel Box with 3 conduit hubs.
 - 3) Stainless steel cover plate.
 - b. Silence/On - Off switch:
 - 1) NEMA Type 4.
 - 2) Maintain position, black, with nameplate.
 - 3) 1 set of auxiliary contacts.
 - c. Power: 0.6 Amps at 120VAC.
- C. Combination unit emergency shower and eye/face wash:
1. Manufacturers: One of the following or equal:
 - a. Haws, Model No. 8309.
 - b. Guardian Equipment, Model No. G1950HFC.
 - c. Bradley, Model No. S19314AC.
 2. Pipe standard:
 - a. 1-1/4-inch hot-dip galvanized steel pipe, and fittings with interconnecting piping, stanchion, and 9-inch diameter floor flange.

- b. Corrosion protection:
 - 1) Manufacturers: One of the following or equal:
 - a) Bradley Galvanized steel with BradTect® safety yellow coating.
 - b) Guardian Equipment “-GC” epoxy protective coating in corrosive environments.
 - c) Haws “-CRP”.
- 3. Shower head:
 - a. Material and size: ABS plastic, 10-inch diameter with 20 GPM flow control.
 - b. Valve and actuator: Stay open chrome plated brass ball valve equipped with stainless steel ball and stem operated by a rigid stainless steel pull rod.
- 4. Eye/face wash receptor:
 - a. Valve and actuator: Stay open chrome plated brass ball valve with stainless steel ball and stem operated by a stainless steel or epoxy coated aluminum push handle and foot treadle.
 - b. Spray head(s): ABS plastic or polypropylene eye/face wash type heads, with integral flip top protective dust covers releasing with water pressure.
 - c. Receptor bowl: Stainless steel; 11 inches diameter.
- 5. Supply: 1-1/4-inch Industrial Piping Systems (IPS).
- 6. Waste: 1-1/4-inch IPS.

D. Safety shower tester:

- 1. Manufacturers: One of the following or equal:
 - a. Bradley, Model No. S19-330ST.
 - b. Guardian Equipment, Model No. AP250-005.
 - c. Haws, Model No. 9010 with No. 9009.
- 2. Kit includes:
 - a. Minimum 5 gallon plastic bucket.
 - b. 7 foot long watertight 12-gallon translucent vinyl plastic bag for attaching over drench showerhead:
 - 1) Bag shall have drawstring at top and be hemmed at bottom.
 - c. Testing record card.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturers' recommendations.
- B. Install products in accordance with code requirements and ANSI Z358.1.
- C. Plumbing and mechanical work as specified in Section 46_05_10 - Common Work Results for Mechanical Equipment.
- D. Electrical connections and distribution as specified in Section 26_05_00 - Common Work Results for Electrical.

3.02 COMMISSIONING

- A. As specified in Section 01_75_17 - Commissioning and this Section.

- B. Functional testing:
 - 1. Shower/eyewash unit with integral controls:
 - a. Test witnessing: Witnessed.
 - b. Electrical Instrumentation and Controls:
 - 1) Test witnessing: Witnessed.

END OF SECTION

SECTION 26_00_00

ELECTRICAL GENERAL

PART 1 GENERAL

1.01 SCOPE

- A. This section specifies general requirements for electrical work. Detailed requirements for specific electrical items are specified in other sections but are subject to the general requirements of this section. The electrical drawings and schedules included in this project manual are functional in nature and do not specify exact locations of equipment or equipment terminations.

1.02 DEFINITIONS

- A. The word "provide" shall be interpreted to mean furnish and install.
- B. "Owner" City of Mercer Island.
- C. "Contractor" is the party who furnishes and installs all materials and equipment. This includes the Prime Contractor, Electrical Contractor, Control System Integrator, and all other Contractors and Sub Contractors.
- D. "Control System Integrator" also referred to as the System Integrator or Integrator or control system manufacturer is the Party that furnishes all control components including motor controls, VFDs and motor control centers and designs the detailed control wiring diagrams plus the layout and assembly of the custom control panels.
- E. "Control System" includes all equipment, instruments, computers and wiring for control and monitoring of all operating pumps and equipment. This includes custom control panels, motor control center, packaged control panels, and control equipment furnished with other systems and mechanical equipment. All sensing, transmitting, indicating, control and recording of all functions as specified and shown are also included in the control system.
- F. "System Programmer" – Provides all programming and related service – has been pre-selected for this project to be:
 - 1. Brown and Caldwell – Contact Samantha Brittain – 206-749-2329.

1.03 GENERAL DESCRIPTION OF WORK

- A. The Contractor shall:
 - 1. Provide all labor, material, tools, equipment, and services required to complete the furnishing, installation, wiring, connection, calibration, adjustment, testing and operation of all electrical equipment, devices and components as indicated and implied by the plans and these specifications.
 - 2. Provide identification (nameplates and wire tags) of all electrical equipment and wiring.
 - 3. Complete the wiring to, connection to, adjustment and calibration of, testing of equipment having electric motors and/or built-in or furnished electrical

- components. Install electrical components that are furnished with mechanical equipment.
4. Complete the procurement, installation, wiring, connection, calibration, adjustment, testing and operation of all electrical devices, components, accessories, and equipment which is not shown or specified but which is nonetheless required to make the systems shown and specified function properly.
 5. Provide the size, type and rating of motor control devices, equipment and wiring necessary to match the ratings of motors furnished with mechanical equipment.
 6. Provide adequate space for the electrical installation, including but not limited to, determination of access-ways and doorways, shipping sections, wall and floor space, and space occupied by mechanical equipment. Provide electrical equipment that fits in the areas shown on the drawings. All equipment shall be readily accessible for maintenance, shall have electrical clearances in accordance with NEC and shall be installed in locations that will provide adequate cooling.
 7. Provide detailed wiring diagrams showing all equipment and instrumentation connections and terminations.
 8. Check electrical equipment prior to installation so that defective equipment is not installed. Acceptance testing for electrical equipment shall be performed as discussed in Section 40_90_00 - Instrumentation and Controls.
 9. Provide start-up, follow-up, and training of the Owner's personnel for electrical systems. Make all corrective measures required during start-up. See specific requirements for training and start-up in other specification sections.
 10. Provide field services of qualified technicians to supervise and check out the installation of the equipment, to supervise and check out interconnecting wiring, to conduct start-up of operation of the equipment, and to correct any problems, which occur during start-up.

1.04 EQUIPMENT COORDINATION

- A. The Contractor is responsible to coordinate the equipment supplied from other manufacturers. This includes but is not limited to:
 1. Obtaining specific information on equipment ratings and sizes and verifying the electrical components supplied meet, or match the requirements such as voltage, phase, frequency, starter types, etc.
 2. Verifying the equipment supplied will fit within the space allocated.
 3. Coordination of equipment and the electrical power and control requirements. Provided in all sections of the specifications and drawings.
 4. Providing power and control equipment, wiring, and raceways to meet the requirements of the mechanical equipment supplied.
 5. Providing all necessary control wiring and components for any special requirements from an equipment manufacturer.
- B. The Contractor shall verify as a minimum:
 1. Correct voltage, phase, and frequency.
 2. Size and space requirements.
 3. Mounting requirements.
 4. Correct motor starter type.
 5. Proper coordination with the controls and control system Integrator.

- C. Any discrepancies between the electrical and other equipment shall be brought to the immediate attention of the Engineer.
- D. The Contractor shall take precautions to minimize instrumentation or control interferences that are created by the variable frequency drives (VFD's) or power wiring. The Contractor shall coordinate with the VFD manufacturer to provide necessary separation of conductors or shielding and/or filtering equipment as required by the VFD manufacturer. All power wiring shall be separated from instrumentation and control wiring by a minimum of 12 inch and 18 inch to any VFD power wiring.

1.05 PROJECT DESCRIPTION

- A. In general, the work consists of two separate projects:
 - 1. Adding a hypochlorite generation (CL2), storage and injection and monitoring system to the reservoir site.
 - 2. Providing an RTU at SPU intertie #68 for flow control and monitoring.
- B. The following statements highlight the main portion of the electrical work:
 - 1. Reservoir Site – Cl2 system:
 - a. Provide circuit breaker in the existing panelboard for power to the CL2 system.
 - b. Provide panelboard for 480V loads.
 - c. Provide transformer and panelboard for 120/240V loads.
 - d. Provide raceways and wiring and installation of the packaged hypochlorite generation system which includes:
 - 1) Brine Tank.
 - 2) Hypochlorite generators with brine pumps.
 - 3) Hypochlorite storage tanks.
 - 4) Dilution blower.
 - 5) Cl2 and Hydrogen gas monitoring.
 - e. Provide water heater for process water and a water heater for the emergency shower.
 - f. Provide mixers in the two reservoirs.
 - g. Provide hypochlorite feed pumps, injection system with automatic valves and controls.
 - h. Provide pH and Cl2 residual monitoring system.
 - i. Provide actuators for two water distribution valve flow (FCV) controllers.
 - j. Provide interface of all equipment and instruments with raceways and wire to the existing MCP for control and monitoring/alarming.
 - k. Provide wire and raceways for all equipment power and control circuits.
 - l. Provide startup, testing, O&M, record drawings and training.
 - 2. SPU Intertie Valve #68:
 - a. Coordinate with the local power utility and provide power service to the site.
 - b. Provide service entrance equipment and metering equipment per the serving utility's requirements.
 - c. Provide power distribution equipment.
 - d. Provide an RTU (Remote Telemetry/control Unit) with PLC for control and local and remote monitoring and alarming of all equipment.
 - e. Provide cellular communications for remote monitoring and interface to the City's SCADA system.

- f. Provide interface to the valve for position control and monitoring.
- g. Provide flow meter with transmitter in the RTU.
- h. Provide intrusion switches & flood switches.
- i. Provide wire and raceways for all equipment power and control circuits.
- j. Provide startup, testing, O&M, record drawings and training.

1.06 TEMPORARY OPERATION AND CONSTRUCTION POWER

- A. Construction Power:
 - 1. If the existing service is adequate for facility operation and construction power, then the existing service may be used for construction power and the Owner shall pay all energy costs as billed by the utility on the existing meter.
 - 2. Any necessary modifications to the existing electrical system for construction power shall be coordinated and paid for by the Contractor.

1.07 STANDARDS AND CODES

- A. Permits, licenses, approvals and other arrangements for work shall be obtained and paid for by the Contractor and included in the bid price.
- B. Electrical work shall be executed in strict accordance with the latest edition of the National Electrical Code and local ordinances and regulations.
- C. All electrical equipment, materials, construction methods, tests and definitions shall be in strict conformity with the established standards of the following in their latest adopted revision:
 - 1. Underwriters' Laboratories, Inc. (UL).
 - 2. National Electrical Manufacturers Association (NEMA).
 - 3. Canadian Standards Association (CSA).
 - 4. Electrical Testing Laboratories (ETL).
 - 5. Factory Mutual (FM).
 - 6. All applicable Washington State Codes and local City Codes.
- D. All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- E. All materials shall be new, free from defects, of current manufacture, of quality specified or shown. Each type of material shall be of the same manufacturer throughout the work.

1.08 CONTRACT DOCUMENTS

- A. The electrical layouts are generally diagrammatic. The location of equipment is approximate unless dimensioned. Exact locations and routing of conduits shall be governed by structural conditions and physical interference's and by locations of electrical terminations on equipment.

1.09 REFERENCE DOCUMENTS

- A. The Contractor shall refer to the drawings, project data and shop drawings of other trades for additional details, which affect the proper installation of the work.

Diagrams and symbols showing electrical connections are diagrammatic only, and so do not necessarily show the exact physical arrangement of the equipment.

1.10 SITE FAMILIARIZATION

- A. Before submitting a bid, the Electrical Contractor shall become familiar with all features of the site, which may affect the execution of the work. The Contractor shall take all field measurements necessary for the work and shall assume full responsibility for their accuracy. The Contractor shall take full responsibility for locating and avoiding all substructures. Any damage to existing equipment shall be repaired or replaced by the Contractor at a cost negotiated with the Owner.

1.11 GROUND SYSTEM

- A. Provide grounding and ground system per the NEC.
- B. Provide a minimum of two 10 foot x 3/4 inch copper coated steel ground rods or more if required by the drawings. Use pressure type connectors for underground connections and bolted type for exposed.
- C. Construct metallic raceways to provide a continuous ground path.
- D. Connect all electrical equipment enclosures to the ground system.
- E. Nonelectrical equipment with metallic enclosures and metallic piping shall be connected to the grounding system as required by NEC.
- F. Ground system shall be tested per IEEE standard 81. If greater than 2 ohms, then additional ground rods shall be added and paid for as extra work.
- G. Bond ground system to metallic piping as required by NEC.
- H. Bond ground system to building steel in at least one location and at other locations as shown on the drawings.

1.12 PRE-SUBMITTAL ELECTRICAL CONFERENCE

- A. The CONTRACTOR shall arrange and conduct a Pre-submittal Electrical Conference (“TEAMS” meeting) within 30 Days after award of the Contract. The purpose of the Conference is to review and approve the manner in which the CONTRACTOR intends to carry out its responsibilities for Electrical and I&C submittals and Shop Drawing submittals and the WORK to be provided under the EI&C specifications. The General Contractor, the Electrical Contractor, the System Integrator, System Programmer the ENGINEER and OWNER shall attend. Both the CONTRACTOR and the OWNER may invite additional parties at their discretion.
- B. The CONTRACTOR shall allot 2 hours (minimum) for the Conference. The conference shall take place via video conferencing. (Teams-Zoom).
- C. The CONTRACTOR shall present the following for discussion at the Conference:
 - 1. Discussion of submittal documents and format – submittals shall be electronic and delivered via email with the subject line as follows:
 - a. “project name, EI&C submittal submittal #, spec section# - description.”

2. Discussion of submittal schedule and critical path and long lead items and any concerns about lead times for any of the products.
3. A sample of submittal control wiring diagrams (equipment, instruments, PLC I/O cards) panel, equipment drawings to be provided.
4. A sample of each type of submittal.
5. A list of clarifications (RFQs) to the Contract Documents along with a brief explanation of each. Resolution shall be subject to a separate formal submittal and review by the ENGINEER.
6. Discussion of nameplates.
7. A list of proposed modifications, deviations from specified components and anticipated change orders.
8. Proposed shop and field testing procedures for electrical equipment and instrumentation and controls.
9. Proposed plan for coordination with the power utility.
10. An overview of the proposed plan for maintaining the operations of the facilities during construction.
11. A preliminary schedule for the following activities:
 - a. Electrical equipment submittals.
 - b. I&C submittal.
 - c. Factory testing.
 - d. Field I/O testing.
 - e. Startup.
 - f. System testing.

1.13 SUBMITTALS

- A. Project data shall be submitted in accordance with the general requirements and the following.
- B. In the front of each submittal document, provide a list of any deviations to the contract documents: materials/products, or installation method that are different than specified.
- C. Submittal documents shall be submitted via E-mail in PDF format. Separate Submittal e-mails shall be provided for each spec section. All products for each spec section shall be included in a single PDF document including the cover sheet and index in one single document. Submittals shall be indexed and identified as follows:
 1. Email subject line shall be "**project name**, EI&C submittal **submittal #**, **spec section# - description**."
 2. Cover sheet with:
 - a. The project name and submittal #.
 - b. Contractor's and sub-contractor's name, phone number, and email address.
 - c. Index sheet showing each product being submitted.
 3. PDF index tabs per the electrical specifications by section and paragraph or equipment name e.g., provide a minimum of one tab section for each piece of equipment in all the PART 2 PRODUCT Sections 2.01 - 2.**.
 4. Label each equipment submittal sheet with equipment name and number. Indicate location where each item of equipment submitted will be used on the job. Use equipment numbers when available.

5. Identify specific options and cross hatch out any information that is not a part of the specific information for the submitted component.
- D. Submittals shall include the manufacturer's name, address, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference. Include other information necessary to establish contract compliance of each item proposed to furnish.
- E. Long lead items may be submitted separately – if pre-approved by the Engineer.
- F. Each item shall be clearly marked and provided with adequate sales and technical information to clearly show conformance with all aspects of the specification. Packages not provided as described above or largely incomplete shall be returned to the Contractor, without comment.
- G. I&C (Instrument & Control) submittals shall be provided with a Bill of Materials showing quantity, manufacturer's name, catalog number, and supplier name and phone number.
- H. Certify on all submittals that the material being proposed conforms to the contract requirements. In the event of any variance, state specifically which portions vary and request a variance in writing.
- I. Certify that all furnished equipment can be installed in the allocated spaces by stating on each item:
"This equipment will be able to be installed in the spaces allocated."
- J. Shop Drawings shall be provided on 11 inch x 17 inch sheets maximum size and shall be scaled using standard engineering or architectural scales. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment.
- K. NOTE: submittals received that do not meet the requirements outlined above and in the individual spec sections will be returned without review.
- L. Contractor should anticipate in the schedule that submittals will take a minimum of 4 weeks for comments to return.
- M. The engineer will have a minimum of 2 weeks to review submittals and a minimum of 3 weeks to review I&C submittals.

PART 2 PRODUCTS

2.01 NAMEPLATES

- A. Nameplates shall be provided on all electrical devices, (including but not limited to motor control equipment, MCC cubicles, control stations, junction boxes, panels, motors, instruments, solenoids, switches, indicating lights, meters, and all electrical equipment enclosures.).

- B. Nameplates shall also be provided on all electrical panel interior equipment, including but not limited to relays, circuit breakers, power supplies, terminals, contactors, and other devices.).
- C. All nameplates shall include the equipment name and number (circuit number and function, if applicable).
- D. Nameplates of all powered equipment (including instruments, motors, control panels, HVAC, etc.) and all switches, disconnects, and receptacles shall have included on the nameplate the power source (circuit and panel number, MCP/control pnl and circuit #, or MCC and unit number, etc.) that the equipment is fed from.
- E. Nameplates on light switches and receptacles shall include the panel and circuit and also include application such as outdoor lights, computer receptacle, etc. if relevant. Nameplates on switches and receptacles can be printed thermal tape.
- F. All motors shall have nameplates secured to the terminal box with 1/2 inch lettering or larger.
- G. Nameplates shall be made of 1/16 inch thick machine engraved laminated phenolic having black letters not less than 3/16 inch high on white background or as shown on the drawings or other sections of the specifications. Nameplates on the interior of panels and on light switches and receptacles shall be White Polyester with printed thermal transfer lettering and permanent pressure sensitive acrylic; TYTON 822 or equal.
- H. All nameplates shall include the equipment name and number (and function, and circuit number if applicable).
- I. Provide warning nameplates on all panels and equipment, which contain multiple power sources. Lettering shall be white on red background.
- J. Provide information or warning nameplates as required by the NEC or electrical inspector for identification of service disconnects, multiple service disconnects, etc.
- K. Nameplates shall be secured to equipment with stainless steel screws/fasteners/straps. Epoxy glue may be used where fasteners are not practical if first approved by the Engineer.

2.02 WIRE MARKERS

- A. Each power and control conductor shall be identified at each terminal to which it is connected. Conductors size No. 10 AWG or smaller shall have identification sleeves. Conductors shall be identified in accordance with Section 26_05_00 - Miscellaneous Electrical.
- B. The letters and numbers that identify each wire shall be machine printed on sleeves with permanent black ink. The figures shall be 1/8 inch high. Sleeves shall be white tubing, sized to fit the conductor insulation. The sleeves shall be shrunk to fit the conductor with hot air after installation.

- C. Wire markers shall be TMS Thermodyn Marker System by Raychem Co., sleeve style wire marking system by W. H. Brady Co., or equal. Adhesive strips are not acceptable. Conductors No. 8 AWG and larger shall use cable markers of the locking tab type. Tabs shall be white plastic with conductor identification number permanently embossed.

2.03 RACEWAY MARKERS

- A. Raceway markers shall be nonmetallic with raceway number stamped in 3/16-inch minimum height characters. Tags shall be attached to the raceway with 316 stainless steel wire.

2.04 THERMAL (TEMPERATURE) RATINGS OF EQUIPMENT TERMINATIONS

- A. Wiring and circuit breakers on this project are designed for 75°C operation above 30 amperes; 60°C for 30 amperes and below.
- B. All products furnished on this project shall have electrical terminations rated for 60°C for ampacities of 30 amperes or less and rated for 75°C for ampacities above 30 amperes.

PART 3 EXECUTION

3.01 STORAGE AND INSTALLATION ENVIRONMENT

- A. All electrical equipment shall be stored in a dry environment free from dust, moisture, sprays, or vapors, which may be detrimental to their new condition. After installation of equipment, care shall be taken to protect all equipment from all dust, moisture, paint and other spray, harmful vapors, etc. until final acceptance and certificates of occupancy have been obtained.
- B. Equipment shall not be installed in indoor areas until the area is covered, dry and finished to the point that other work will not create dust, vapors, or moisture. Equipment with integral heaters and fans shall not be installed until power is available at the location and the heater and fan shall be energized within 6 hours of the equipment being installed.

3.02 SITE INSPECTIONS

- A. Prior to final acceptance the Engineer will perform one or more site observation trips to develop a "punch list" of items deemed incomplete.
- B. Each punch list item shall be completed by the Contractor and checked off the list. When all the items on the list are completed or commented on, the list shall be signed by the Contractor and returned to the Engineer for verification.

3.03 FINAL ACCEPTANCE

- A. When all work is complete, the Contractor shall call the Engineer for the final acceptance testing inspections. The Electrical Contractor and System Integrator shall be present while these inspections are taking place and shall be available for opening cabinets and operating and adjusting the system as is necessary for the

Engineer to verify all equipment is installed and operates to the requirements of the contract documents.

- B. The contractor shall anticipate a minimum of 40 hours to complete the final acceptance testing.
- C. Prior to the Contractor calling for this observation, the Contractor shall have completed all items of work, including wire markers, nameplates, final tests, and final test reports. All equipment shall be checked for proper operation and all signals verified for correct calibration and wiring.
- D. Final acceptance will not be given until:
 - 1. All work is complete.
 - 2. All "site inspection" punch-lists are checked off and returned to the Engineer.
 - 3. All test reports are received.
 - 4. All O&M manuals are received.
 - 5. All spare parts are received.
 - 6. All instrument test forms are received.
 - 7. All project record drawings are received.

3.04 PROJECT RECORD DRAWINGS

- A. A set of drawings shall be maintained at the job site (by the Electrical Contractor) showing any deviations in the electrical systems from the original design.
- B. This set of drawings shall be always readily available for inspection by the Engineer.
- C. Another complete set of drawings shall be marked up in the office showing the changes made on the field set of drawings. All changes shall be clearly marked in red on the drawings. Drawings shall be submitted to the Engineer at the completion of the project.
- D. A set of electrical drawings marked in red to indicate the routing of conduit runs, shall be submitted to the Engineer for review at the completion of conduit rough-in and prior to cover or pouring of concrete.

3.05 GUARANTEE

- A. The Contractor shall guarantee his work and all components thereof, excluding fuses, incandescent and fluorescent lamps for a period of 1 year from date of acceptance of the installation. The Contractor shall remedy any defects in workmanship and repair or replace any faulty equipment that shall appear within the guarantee period without additional cost to the Owner.

3.06 CLEANUP

- A. The premises must be kept free of accumulated materials, rubbish, and debris at all times. Surplus material, tools and equipment must not be stored at the job site. At the completion of the job, all equipment and fixtures shall be left clean and in proper condition for their intended use.
- B. All motor control equipment and control panels shall be cleaned inside and out at the completion of the project.

3.07 TESTS

- A. Testing for installed feeder cables and motors is required as specified in other Sections. Test reports shall be submitted to the Engineer prior to final acceptance. All tests shall be performed in accordance with the applicable sections of NETA.
- B. Where specified in the individual product specification section, factory tests shall be performed at the place of fabrication and performed on completion of manufacture or assembly. The costs of factory tests shall be included in the contract price.

3.08 MAINTAINED OPERATION REQUIREMENTS

- A. This is an existing and operating facility and must remain operational during construction.
- B. The Contractor shall submit a plan with dates and times for all required power outages and power switchovers for review and approval prior to any power disruptions.

3.09 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall prepare and assemble detailed operation and maintenance manuals. The manuals shall be bound in a 3 ring binder and tabbed with an index, in general the O&M manual format shall meet that of the submittal data in this section. The manuals shall include, but not be limited to, the following:
 - 1. Catalog data and complete parts list for all equipment and devices.
 - 2. All cut sheets of equipment and components.
 - 3. Preventative maintenance procedures.
 - 4. Trouble-shooting.
 - 5. Calibration.
 - 6. Testing.
 - 7. Replacement of components.
 - 8. Automatic mode operation.
 - 9. Manual mode operation.
 - 10. System schematics / shop drawings and record drawings.
 - 11. As-built wiring diagrams of cabinet and enclosure contained assemblies.
 - 12. As-built wiring diagrams of overall system.
 - 13. Listing of recommended spare parts.
 - 14. Listing of recommended maintenance tools and equipment.

3.10 TRAINING

- A. Training shall be provided per the specific requirements in other Sections of these specifications. The Contractor shall conduct specifically organized training sessions in the overall operation and maintenance of the electrical system for personnel employed by the Owner. The training sessions shall be conducted to educate and train the personnel in operations and maintenance of all components of the electrical system outside the training requirements in the other Sections. Training shall include, but not be limited to, the following:
 - 1. Preventative maintenance procedures.
 - 2. Trouble-shooting.
 - 3. Calibration.
 - 4. Testing.

5. Replacement of components.
 6. Equipment operation.
- B. Training sessions shall be conducted at the facility after start-up of the system. The Contractor shall prepare and assemble specific instruction materials for each training session and shall supply such materials to the Owner at least 2 weeks prior to the time of the training.

END OF SECTION

SECTION 26_05_00

MISCELLANEOUS ELECTRICAL

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. This section covers furnishing and installing miscellaneous electrical devices and equipment and other wiring devices indicated on the drawings.

1.02 STANDARDS AND CODES

- A. All materials and equipment specified herein shall within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- B. All materials and equipment specified herein shall conform to all applicable NEMA, ANSI and IEEE standards.
- C. All materials and equipment specified herein, and their installation methods shall conform to the latest published version of the National Electric Code, N.E.C.

1.03 COORDINATION

- A. The Contractor is responsible for coordination of mechanical equipment, fans, louvers, heaters, motors, starters, etc. and the electrical power and control requirements. Provided in this section and other sections of the specifications and drawings.
- B. The Contractor shall provide power and control equipment, wiring, and raceways to meet the requirements of the mechanical equipment supplied.
- C. The Contractor shall verify as a minimum:
 - 1. Correct voltage, phase, and frequency.
 - 2. Correct motor starter type.
 - 3. Proper coordination with the controls and control system Integrator.
- D. The Contractor shall provide all necessary control wiring and components for any special requirements from an equipment manufacturer.
- E. Any discrepancies between the electrical and mechanical equipment shall be brought to the immediate attention of the Engineer.

1.04 SUBMITTALS

- A. In accordance with the "submittals" requirements in Section 26_00_00 - Electrical General, submit catalog data showing material information and conformance with specifications. The intended use of each item shall be indicated.

- B. Submittal documents shall be submitted via E-mail in PDF format. Separate Submittal e-mails shall be provided for each spec section. All products for each spec section shall be included in a single PDF document including the cover sheet and index in one single document. submittals shall be indexed and identified as follows:
1. Email subject line shall be "**project name**, EI&C submittal **submittal #**, **spec section# - description**."
 2. Cover sheet with:
 - a. The project name and submittal #.
 - b. Contractor's and sub-contractor's name, phone number, and email address.
 - c. Index sheet showing each product being submitted.
 3. PDF index tabs per the electrical specifications by section and paragraph or equipment name e.g., provide a minimum of one tab section for each piece of equipment in all of the PART 2 PRODUCT Sections 2.01 - 2.**.
- C. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
- D. For motors on VFDs submit verification that the installation is approved by both the VFD and motor manufacturer – submit on any line terminators or filters that the manufacturers recommend for the application.
- E. Provide all electrical information – wire diagrams, terminal information and numbering and electrical / power data.
- F. Submit verification that stainless steel hardware will be used as required by this specification.

PART 2 PRODUCTS

2.01 RACEWAYS

- A. General:
1. All wiring shall be installed in raceways.
 2. Ground Conductor:
 - a. All raceways shall contain a minimum of one continuous copper equipment grounding conductor sized in accordance with the N.E.C.

B. Area Classifications:

1. The following classification of areas shall be used as a reference in determining application of material covered by this Section unless specifically shown otherwise on the drawings. Areas which fall under two or more of the following classifications shall conform to the minimum requirements of all the area classifications listed for that area.
2. Outdoor and Damp Areas:
 - a. All outdoor areas:
 - 1) Raceway shall be rigid galvanized steel (GRS), Intermediate Metal Conduit (IMC). Conduit entrances shall be threaded, and fittings shall have gasketed covers.
 - 2) Threaded fastening hardware and rods shall be 316 stainless steel. Raceway supports such as channel, clamps, and brackets shall be 316 stainless steel or aluminum or non-metallic.
 - 3) Panels and boxes shall be NEMA 3R - aluminum, stainless steel or non-metallic (or as shown on the drawings). Device boxes shall be cast, copper free aluminum.
3. Corrosive Areas:
 - a. Hypochlorite area, equipment and instruments associated with the hypochlorite system, Inside vaults:
 - 1) Raceway shall be PVC coated GRC.
 - 2) Raceway supports such as channel, clamps and brackets shall be non-metallic nylon PVC coated aluminum. Threaded fastening hardware and rods shall be 316 stainless steel.
 - 3) Enclosures shall be NEMA 4X 316 stainless steel, aluminum or non-metallic (or as shown on the drawings).
4. General Purpose Areas: All other areas not described above:
 - a. Raceway shall be GRC or IMC.
 - b. Raceway concealed in walls or ceilings for general purpose lighting and receptacle circuits may be EMT.
 - c. Exposed boxes shall be NEMA 12. Concealed boxes may be NEMA 1. Boxes poured in concrete shall be Cast.

C. Raceway Application:

1. Unless otherwise shown on the drawings, ABOVE GRADE CONDUITS shall meet the requirements of the "area classification" listed above and shall be:
 - a. GRC, IMC, PVC coated GRC.
2. Unless otherwise shown on the drawings, CONDUITS BELOW GRADE shall be:
 - a. Schedule 40 PVC - GRC, PVC coated GRC (PGRC) as listed below:
 - 1) Sweeps and risers for transition of PVC from below grade to above grade shall be GRC or PGRC.
 - 2) Conduits entering and inside of vaults or other corrosive areas shall transition to PVC coated GRC a minimum of 4 feet outside the structure or corrosive area.
 - b. GRC, PVC coated GRC, Stainless Steel or aluminum for signal and communications wiring.
 - c. GRC, PVC coated GRC, Stainless Steel, or aluminum for motor leads from VFD's.
3. ALL CONNECTIONS TO VIBRATING EQUIPMENT or motors shall be:
 - a. Liquidtight flexible metallic conduit for indoor, noncorrosive areas and all motor leads from VFD's.

- b. Connections to equipment outdoors or in corrosive areas shall be with nonmetallic liquid tight flexible conduit (except for motor leads from VFD's shall be flexible metallic.).
4. All raceways materials, sizes, etc. for UTILITY SERVICE shall be per the serving utilities requirements.

D. Conduit:

1. Galvanized Rigid Steel Conduit (GRC):
 - a. Rigid conduit shall be steel, galvanized. Terminations shall be by means of threaded hubs or double locknuts and insulating grounding type bushings.
2. Intermediate metal conduit (IMC):
 - a. Intermediate metal conduit shall be of steel and shall be galvanized. Fittings shall be threaded.
3. Flexible Conduit (LFS):
 - a. Flexible conduit shall be interlocking single strip, galvanized and shall have a polyvinyl chloride jacket extruded over the outside to form a flexible watertight raceway. Non-metallic flexible conduit shall have nonmetallic threaded fittings.
4. Nonmetallic Conduit(PVC):
 - a. Nonmetallic conduit shall be rigid PVC, Schedule 40 or 80. PVC installed above grade shall be UV resistant schedule 80. Fittings shall be of the same material as the raceway and installed with solvent per the manufacturer's instructions. Conduit, fittings, and solvent shall all be manufactured by the same manufacturer.
5. PVC Coated Rigid Steel Conduit (PGRC):
 - a. Coating: A Polyvinyl Chloride (PVC) coating shall be bonded to the galvanized outer surface of rigid steel conduit. The bond between the PVC coating and the conduit surface shall be greater than the tensile strength of the plastic. The thickness of the PVC coating shall be a minimum of 0.035 inches (35 mil) (40 mil nominal).

E. Boxes and Fittings:

1. General:
 - a. Materials for fittings shall be chosen to satisfy the requirements of - Area Classification described above.
 - b. Junction boxes, terminal boxes, device boxes, fixture support boxes, oblong, round, and rectangular conduit fittings (condulets) shall be of the same material as required by the Area Classification for the raceway.
 - c. Boxes larger than 9 inch x 9 inch shall be hinged.
 - d. Cast fittings and boxes shall be:
 - 1) zinc electroplated cast ferrous alloy:
 - 2) Integrally cast threaded hubs or bosses shall be provided for all conduit entrances and shall provide for full 5 thread contact on tightening. Drilling and threading shall be done before finishing.
 - 3) The cover plate shall be of similar cast ferrous alloy material and finish. A full body neoprene gasket shall be provided with the cover. Stainless steel screws shall be provided for all covers.
 - e. All screws, nuts, bolts, straps, rods, and other hardware used with supports, fittings and boxes shall be 316 stainless steel.

F. Handholes and Vaults:

1. Handholes and vaults shall be 24 inch X 36 inch X 36 inch deep minimum size or minimum dimensions as shown on drawings. All handholes and vaults shall be minimum 3000 psi pre-cast, reinforced concrete construction and shall have concrete bottoms with sumps.
2. Walls shall be provided with boxouts with waterstops on all sides of each boxout. Boxouts shall be sized to accommodate the penetrating underground duct banks.
3. Standard Covers shall be hinged diamond plate galvanized steel with H2O loading and latch and lifting handles. Covers shall open 180 degrees. Utility Vault 3030-P, 2436-P or equal.
4. Wire Racks – Provide wire racks for all wiring inside handholes and vaults so that all wiring is supported above the bottom of the handhole.
5. Handholes and vaults and covers shall be constructed per standards and quality of Utility Vault Company 233-LA, 444 LA or approved equal. Covers shall be chosen to fit the handhole or vault provided.
6. Provide drainpipe for watertight covers from cover drain to nearest sump, drain, or as recommended by the manufacturer. If no drain area is nearby, provide a 3 foot cubic area of drain rock and run cover drains to the area.
7. Wiring of different classes or that must be in separate raceway systems (in accordance with the NEC) in the same handhole shall be separated by continuing raceways inside the handhole and installing a 316 SS or non-metallic NEMA 4X pull box in the handhole.

G. Conduit & Cable Supports:

1. Rivet-type or Zamac fasteners are not allowed. All fasteners between channel, strut, etc. and walls shall be removable with a screwdriver.
2. Support materials in general purpose areas may be hot-dip or electro-galvanized. All support materials used in damp areas, pump rooms, or outdoor, or corrosive areas shall be NEMA 4x Aluminum, Stainless steel, or non-metallic.
3. All screws, nuts, bolts, and other hardware used with conduit and cable supports shall be 316 stainless steel.

2.02 CONDUCTORS

- A. All conductors shall be stranded copper. Insulation shall be XHHW, chosen to satisfy environmental conditions. Conductors used for power circuits shall not be smaller than No. 12. Control conductors may be No. 14.

2.03 SHIELDED SIGNAL CABLE

- A. Signal conductor cable shall be AWG #16 individually twisted, shielded pairs. BELDEN, or equal. Conductors shall be tinned copper with color coded 90 degrees C PVC insulation and individual conductor jacket of nylon. Shielding shall be aluminum polyester 100 percent shield coverage with drain wire. The cable shall have an overall PVC jacket. The insulation system shall be rated for 300 volts.
- B. For applications where 600 volt insulation is required, use:
1. BELDEN or equal.
 2. #18 TWSP, stranded wire.
- C. 600 volt insulated signal wire shall only be used where required by Code.

2.04 CONNECTORS

- A. **All wiring shall be continuous from point to point** – no splices of any kind are allowed. All control and signal wire shall land on numbered terminals. Splices are only allowed under special circumstances and only with pre-approval of the Owner and as described below:
1. Ideal Industries "Wing Nut" or 3M Company "SCOTCHLOCK" pre-insulated connectors may be used for general purpose lighting and receptacle circuits for splices and taps in conductors No. 10 AWG and smaller. For No. 8 AWG and larger conductors, utilize T&B compression connectors. Compress using recommended die and tools.
 2. For connections of wire to cord to removable equipment provided with integral cords (such as floats, transmitters, limit switches, aerators, submersible pump motors, etc.) Provide junction box with terminals and spade/lug type terminations and coat with liquid insulation – Performix Liquid Tape or equal.
 3. For connections of wire to cord to Submersible motors of all size wire use a waterproof motor stub insulator. Thomas and Betts multi splice insulator MSLT112-4 or equal.

2.05 SPLICE INSULATION

- A. Splice insulation shall be equal to the conductor utilized.
- B. Insulate all permanent splices that are underground or in damp or corrosive environments with cast epoxy type insulation which covers the jacket of all cords and the insulation on all wire. Epoxy splice shall be Scotch #3570 or equal.

2.06 MOTOR TERMINAL SPLICE INSULATION

- A. Provide motor terminal splice insulation in the motor connection box that will withstand constant vibration and abrasion without degrading the insulation of the splice. A product shall be used that is specifically designed for the purpose of motor terminations.

2.07 WIRE MARKERS

- A. Field installed wire markers shall be pre-printed, heat shrink type sleeves, Thomas&Betts Type HVM, Tyton Type THS or approved equal. See paragraph below for marking requirements.

2.08 SWITCHES AND RECEPTACLES

- A. Standard wall switches shall be single-pole, or double-pole, three-way, as shown on the drawings or as required for the application. Switches shall be AC quiet type rated 20 amp, 125/277 volt with screw terminals. Wiring devices shall be ivory colored for general use office areas, and black when installed in mechanical rooms or when mounted on dark walls. Receptacles on emergency or backup power shall be labeled or color coded. ARROW HART, BRYANT, HUBBELL, P&S or equal.
- B. Weatherproof switches for use in damp, corrosive or outdoor applications shall be:
1. Die cast aluminum housing with lever type switch CROUSE-HINDS, DS185.
 2. or nonmetallic, UL marine listed, CARLON, E98TSC or equal.

- C. Weatherproof receptacles for use in damp, corrosive or outdoor applications shall be:
 - 1. Die cast aluminum with spring and gasketed covers CROUSE-HINDS, WL series.
 - 2. or nonmetallic, CARLON or equal.
- D. Provide GFI receptacles where required by the NEC.
- E. Per the nameplate requirements, provide circuit and panel data labels on all switches and receptacles and label all light switches with function.
- F. Plates:
 - 1. Scope: Provide plate for each wiring device, for each signal or communication outlet.
 - 2. Device plates on flush devices, in general, shall be satin finish stainless steel Sierra 302 stainless steel line or approved equal, modern classic design, corrosion resistant. Special finish plates shall be provided to match special paneled walls as directed by Architect.
 - 3. Device plates for switches and receptacles in outdoor areas shall have weatherproof plates with hinged cover and stainless steel screws. Sierra Electric WP series or equal.
 - 4. Plates on exposed wiring shall be of metal, of the same manufacture as the conduit fittings; specifically suited for device and fitting used.
 - 5. Blank, Bushed or Special Outlet Plates: Provide for all signal communication system outlets as required.
- G. Special Accessories:
 - 1. Provide accessories such as junction boxes, outlet boxes, etc. necessary to mount switches and receptacles in a proper and approved method.

2.09 HEATING AND VENTILATING EQUIPMENT

- A. Unit Heaters:
 - 1. Choose appropriate heater for the voltage and capacity as shown on the drawings. Heaters shall be resistance type with totally enclosed fan motor. Provide necessary auxiliary control equipment for complete operation as shown on the drawings. Provide all necessary mounting hardware for installation.
 - 2. Provide separate thermostats for all unit heaters. Provide with local disconnect if required by code. All thermostats shall be heavy duty, industrial grade and shall include setpoint numbers on adjustable dial.
 - 3. Unit heaters shall be provided with integral 24V control transformer. Provide heavy duty magnetic contactors for all 3 phase heaters and for all single phase heaters larger than 5KW.
 - 4. Provide with thermal cutouts for disconnecting power if overheating occurs.
 - 5. Industrial Unit Heater - Unit heaters shown installed in damp areas such as pump rooms and vaults shall be corrosion resistant construction, phosphate undercoating and powdercoat finish. Size and ratings as shown on the drawings. Heaters shall be Chromalox Type KUH or equal. Provide with remote thermostat Chromalox type WR-80, or WCRT or equal.
- B. Thermostats:
 - 1. For damp/corrosive areas Provide Chromalox type WR-80, or WCRT or equal.

2.10 DRY TYPE TRANSFORMERS

- A. Dry type transformers shall be constructed of heavy gauge sheet steel. Coil and terminal chamber shall be constructed with guarded opening for ventilation and convection cooling. Transformer shall be connected for the application. Unless otherwise shown or required for the application, primary coil shall be delta connected, secondary coil wye connected.
- B. Separate primary and secondary windings shall have Class H insulation and shall be rated for continuous operation at rated kVA with temperature rise of not over 150 degrees C above a 40 degree C ambient, with a maximum hot spot temperature of 220 degrees C. Windings, core, and coil assembly shall be treated and built to resist the effects of dirt and moisture.
- C. Unless otherwise noted or shown, transformers shall be provided with a minimum of four full capacity taps, minimum of two 2-1/2 percent above and two 2-1/2 percent below normal (rated) primary voltage.
- D. Transformers furnished shall have a continuous rating of not less than the size noted on the drawings.
- E. The secondary neutral terminal on three-phase K-rated transformers shall be sized for 200 percent of secondary phase current.
- F. Provisions for external connections shall be made by means of a terminal board employing lugs compatible for the external conductors to be installed.
- G. The core of the transformer shall be grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable NEMA, IEEE ANSI standards.
- H. Provide grounding per NEC.
- I. Provide enclosures per the requirements of the area installed – NEMA 3R for outdoor and damp areas, NEMA 12 for indoor areas.
- J. Acceptable manufacturers for dry type transformers shall be General Electric, Cutler Hammer, Square D, Heavy Duty, and approved equals.

2.11 PANELBOARDS

- A. Panelboards shall be rated at proper voltage and current for intended use with bus bars of tin plated copper or aluminum. Panels shall have phases, voltage and current ratings as shown on the drawings. Panels shall have 100 percent neutral, with equipment ground bar, unless noted otherwise. Panelboards shall be dead front.
- B. Panels shall have as a minimum the number of circuits shown on the panel schedules on the drawings.
- C. The following interrupting capacity shall be considered minimum. Other ratings shall be as specified on the drawings:
 - 1. 240V and 208Y/120V – sub-fed Panelboards 10,000 AIC symmetrical.

2. 240V and 208Y/120V – Service Panelboards 20,000 AIC symmetrical.
 3. 480V Panelboards 30,000 AIC symmetrical.
- D. Provide service entrance rated panelboards were shown on the plans or required by the NEC.
 - E. Provide enclosures per the requirements of the area installed – NEMA 3R for outdoor and damp areas, NEMA 12 for indoor areas or as shown on the drawings.
 - F. Mount breakers in all panelboards so that breaker handles operate in a horizontal plane. Circuit breakers shall be bolt-type only. Provide common trip on all multiple pole breakers.
 - G. Where noted, provide spare breakers, complete for future connection of wiring circuits. Where "Space Only" is indicated for breakers, provide all bussing and breaker mounting hardware in the panelboard; provide steel knockouts in dead front metal closure of unused part of panel. If any steel knockouts are removed, provide breakers in such spaces or approved cover plates. Open spaces are not permitted.
 - H. Panelboards shall be flush, or surface as indicated; tight closing doors without play when latched. Where two cabinets are located adjacent to each other in finished areas, provide matching trim of the same height.
 - I. Provide cabinets of sufficient dimensions to allow for future expansion and addition of circuit breakers within the panelboards as indicated on drawings.
 - J. Provide lock for each cabinet door. All Electrical distribution equipment locks to be keyed identically.
 - K. Fasten panelboard with machine screws with oval countersunk heads, finish hardware quality, with escutcheons or approved trim clamps. Clamps accessible only when dead front door is open are acceptable. Surface mounted panelboards with fronts greater than 48 inches vertical dimension shall have trim hinged at right side in addition to hinged door over dead front.
 - L. Provide factory standard lacquer or enamel finish, ASA #49 gray.
 - M. Provide Surge arrestors, with indicators, where shown on the one-line diagrams to protect against overvoltage transients. JOSLYN J9200 series with protective capacitor GE model 9L18 or equal. Select proper components for the application as shown on the drawings.
 - N. Numbering and buss arrangement shall be as shown on the Panel Schedules on the drawings.
 - O. Provide a type written circuit directory card for each panelboard with the load name, number, location, and kVA.
 - P. Provide engraved (color layer - engraved through outer layer) plastic name plate with 1/2 inch high characters for panel identification (for panel name); attached with stainless steel screws to each panelboard front. Emergency system - white on red; Normal system - black letters on white. Include voltage, phase, and wire (i.e., 208Y/120V, 3 phase, 4 wire) in 3/8 inch characters.

- Q. Secure in place with top of cabinet at 6 foot - 6 inch, unless otherwise noted. Top of cabinet and trim shall be level.
- R. For each branch circuit panelboard: Provide neatly type written as-built information for each panelboard by circuit with its proper load designation. Mount the panelboard circuit directory inside the door of each panelboard in a clear plastic sleeve. Provide one spare blank card for each card used.
- S. Close all openings in dead front with closures manufactured for the purpose or install spare breakers.
- T. Surge Suppression:
 - 1. Where surge suppressor (SPD or TVSS) is specified or shown on the drawings, provide integral surge suppression device with the following minimum characteristics:
 - a. Surge Current per phase – 120kA.
 - b. Surge Current L – N60kA.
 - c. IEEE C3 Wave (10kA) – 9,000.
 - 2. Unit shall have overcurrent protection, infrared and thermal detection - Include diagnostic package and direct bus bar connection and 10 year warranty - Cutler Hammer Clipper CPS-S or equal.

2.12 FUSES

- A. Fuses shall be of the type and amperage indicated on the drawings. The voltage rating shall be appropriate for the application indicated. The fuse types indicated on the drawings imply a certain set of fuse characteristics. No substitutions of fuse types will be allowed without written approval from the Engineer.
- B. All fuses used on the project shall be provided with “blown fuse” indicators.
- C. Where fuses in motor circuits are indicated but not sized, provide Manufacturer's recommended fuse size based on actual motor installed.
- D. Provide in-line or integrally-mounted fuse clips on control power or low-voltage transformer.
- E. Provide fuse puller or pullers for fuse sizes used.
- F. Provide surface mounted cabinet, sized to store required spare fuses at location coordinated with Owners Representative.
- G. Provide a minimum of two spare fuses for each fuse used.
- H. Acceptable Manufacturers:
 - 1. BUSSMAN.
 - 2. GOULD SHAWMUT.
 - 3. LITTLEFUSE.
 - 4. RELIANCE.

2.13 MOLDED CASE CIRCUIT BREAKERS

- A. Molded case circuit breakers shall be quick-make and quick-break type. They shall have wiping type contacts. Each shall be provided with arc chutes and individual trip mechanisms on each pole consisting of both thermal and magnetic trip elements. Two and three pole breakers shall be common trip. All breakers shall be calibrated for operation in an ambient temperature of 40 degrees C. Molded case circuit breakers shall be trip-free. Each breaker shall have trip indication independent of the ON or OFF positions.
- B. Breakers shall have lugs UL listed for both copper and aluminum.
- C. All 480V circuit breakers shall be provided with adjustable Thermal trips. (adjt).
- D. Circuit breakers shall be capable of accepting the cable shown on the drawings. Circuit breakers not capable of accepting the cable shown shall not be acceptable.
- E. Breakers shall have the interrupting rating and trip rating indicated on the drawings.
- F. All breakers that serve motor loads shall be provided with disconnect handle mechanism to lock out the circuit in the open position.

2.14 DISCONNECTS

- A. Provide local equipment disconnects only if required by the manufacturer or NEC.
- B. Disconnect's rating shall be chosen by the Contractor to meet the requirements of the equipment served.
- C. Switch shall be heavy duty type, shall be quick-make quick-break and shall be horsepower rated. Switch shall have blades as required to open all ungrounded conductors and shall be single throw unless noted.
- D. Enclosure shall be suitable for location in which mounted:
 - 1. Enclosures located outdoors or in damp or corrosive areas shall be NEMA 4X, aluminum or stainless steel.
- E. Fusible disconnects shall be as above with addition of fuse space and clips to accept Class R fuses. Use only where required by equipment manufacturer to meet UL installation requirements.
- F. Disconnects for motor loads shall be lockable in the open position.

2.15 MOTORS

- A. General:
 - 1. Unless specifically accepted, all motors shall be of the "energy efficient" or "energy saver" type which meet the minimum efficiencies required by the Washington State energy codes:
 - a. All Motors shall be suitable both electrically and mechanically to drive the connected equipment under any and all modes of operation without exceeding the FLA (Full Load Amps) rating of the motor.

2. All motors shall be suitable for the environment in which they are to be installed. The environment in which motors will be installed in this project will be 100 percent humidity continuously.
3. Motor voltages shall be chosen to meet the requirements of the electrical system. The Contractor shall choose the motor voltages to meet what is shown on the plans.
4. Motor enclosures shall be totally enclosed fan cooled (TEFC) unless otherwise specified or required by the environment installed. Provide explosion proof non-ventilated - (XPNV) or fan cooled (XPFC) motors in hazardous areas.
5. All single-phase motors shall be self-protected. Single phase motors shall be provided with start capacitors if necessary, for proper operation of the motor. The start capacitors shall be located within the motor housing.
6. Enclosed Motors: Provide drain plugs for non-explosion proof motors and drain and breather for explosion proof motors.
7. Finish: Provide a prime and final finish of the manufacturer's standard colors.
8. Provide imbedded thermostats for thermal alarm or motor cut out for all motors 40 Hp and above unless otherwise shown.
9. Provide a terminal connection box two sizes larger than normal to allow extra room for motor feeder splices. Refer to Motor Terminal Splice Insulation requirements.
10. Provide NEMA Class B insulation, minimum, with additional nonhygroscopic moisture protection which will maintain a minimum resistance of 1.0 megohms after 168 hours of exposure at 100 percent humidity.
11. Provide motors with a 1.15 service factor at maximum motor operating load.

2.16 HARDWARE

- A. The Contractor shall provide any necessary hardware for mounting equipment and devices. The mounting hardware shall be made of materials suitable for the environment installed. Provide materials made from aluminum, non-metallic, or stainless steel in outdoor, damp, or corrosive areas.

PART 3 EXECUTION

3.01 GENERAL

- A. Provide services of an authorized representative of manufacturer to visit site of work and inspect, check, adjust if necessary, and approve equipment installation.
- B. Assure that equipment manufacturer's representative is present when equipment is placed in operation.
- C. Verify that equipment representative revisits job site as often as necessary until all trouble is corrected and equipment installation and operation are satisfactory, in opinion of Engineer.
- D. Verify that motor overcurrent protection is in accordance with the N.E.C.
- E. Verify the motor protection and control is in accordance with the equipment manufacturers requirements.

3.02 WIRE & RACEWAY SIZING

- A. The contractor shall size wire per NEC for the load being served. Raceways shall be sized per NEC for the wire or cables installed. Scheduled raceways and wire sizes are minimum size and contractor shall upsize if required for installation per the NEC.
- B. Size pull and terminal boxes per NEC. Pull box sizes, if shown on the drawings, are minimum size and the contractor shall upsize if required by NEC.

3.03 OUTLETS AND SWITCHES:

- A. General:
 - 1. For all receptacles, switches, and other related devices of the lighting and receptacle system, provide all necessary raceway and wire for a complete installation.
 - 2. Center all outlets with regard to building lines, furring and trim. Symmetrically arrange outlets in the room. Satisfactorily correct outlets improperly located or installed.
 - 3. Set outlets plumb and extend flush outlets to the finished surface of the wall, ceiling, or floor without projecting beyond same.
 - 4. Install symmetrically all receptacles, switches and outlets shown on the trim and where necessary, set the long dimension of the plate horizontal or gang in tandem.
 - 5. Outlets in outdoor areas or wet areas shall be GFI – provide GFI outlets in other areas as required by Code.
- B. Mounting Heights:
 - 1. Unless otherwise noted, wall mounted outlet devices shall generally be 24 inches above the floor, 18 inches in architecturally treated areas. In basement, underground or in areas subject to flooding, outlets shall be 36 inches above the floor.
 - 2. Switches shall be mounted 48 inches above the floor.
 - 3. Outlets mounted over worktables, desks and counters shall be 2 inches - 6 inches above the work surface.

3.04 RACEWAYS

- A. General:
 - 1. Not all conduits/raceways are scheduled. Wire diagrams and oneline diagrams show wiring requirements. Provide all necessary raceways for wiring as shown on the drawings.
 - 2. For all power and control equipment, provide all necessary raceways and wire per plans and specifications even if not specifically shown on the plans.
 - 3. Raceway routing shown on plans is general in nature, unless otherwise indicated on the drawings, the Contractor shall be responsible for determining conduit routing that conforms to the installation requirements required by the plans and specifications.
 - 4. The number of directional changes of a conduit shall be limited to 270 degrees in any run between pull boxes.
 - 5. Conduit runs shall be limited to a maximum of 400 feet, less 100 feet or fraction thereof, for every 90 degrees of change in direction.

6. In general, conduit inside structures shall be exposed unless otherwise specified or indicated on the drawings. No conduit shall be exposed in water chambers unless so indicated on the drawings.
 7. Provide raceways/conduits per the conduit and wire schedule and additional as necessary to meet the requirements of the wiring.
 8. Scheduled conduit sizes are minimum. Contractor shall upsize conduits if necessary or if required by the NEC.
 9. Non-scheduled conduits shall be a minimum of 3/4 inches or sized per the NEC for the wiring installed plus 20 percent.
 10. Conduit across structural joints where structural movement is allowed shall have an O-Z "Type DX" or Crouse-Hinds "Type XD," bonded, weathertight expansion and deflection fitting of that conduit size.
 11. Separate conduits of different voltages by a minimum of 2 inches – separate signal wire conduits from all other types of conduits by a minimum of 6 inches.
 12. All conduits shall be a minimum of 3/4 inches.
 13. Conduits entering underground structures shall be made watertight – see "handholes and Vaults" for more requirements.
- B. Sealing of Conduit:
1. Conduits passing from a corrosive area into a noncorrosive area, shall be provided with a sealing fitting which shall be located at the boundary.
- C. Handholes and Vaults:
1. Sizes of handholes and vaults shown on the drawings are minimum sizes. If space allows the Contractor may upsize the structures for ease of pulling or if required by the NEC.
 2. Conduits entering energized equipment shall have both conduit ends sealed with a waterproof duct sealing compound - WATERGUARD Industrial Encapsulant or equal. Where conduits enter through sides of handholes the penetration shall be made watertight.
 3. Provide a minimum of 12 inches deep of 3/4- to 1-inch drainage gravel under entire surface and extending 12 inches beyond the outside edge of the structure in all directions - of all vaults and handholes.
 4. All wire installed in handholes and vaults shall be neatly bundled and racked to the handhole or vault side walls.
 5. Provide welded stainless steel nameplate on each handhole and vault cover with the tag number and contents (480v, 120v, power, control, signal, etc.) clearly indicated.
 6. Before final inspection, all vaults and handholes shall be cleaned and washed out with high pressure water to remove all dirt and debris and sumps shall be knocked out.
 7. Provide drains from watertight lids to nearest sump, wet well, or provide a 3 foot cubic drain area filled with drain gravel for draining handhole/vault covers.
 8. Conduits entering substructures that contain electrical equipment shall first enter a Non Metallic junction box near the bottom of the box and then continue out of the top of the box to create a water break to stop water from entering electrical equipment – drill a 1/4 inch weep hole in the junction box to drain away water.

3.05 WIRE AND CABLE INSTALLATION

- A. Splices in power and control and signal wires or cables is not allowed. All wire transitions shall be done on terminals.
- B. Keep all conductors within the allowable tension limits during installation. Lubricants for wire pulling, if used, shall be approved for the insulation and raceway material. Observe cable manufacturer's and industry standard cable bending radius recommendations.

3.06 WIRE AND CABLE TERMINATION

- A. General:
 - 1. Power conductors, No. 8 AWG and larger may be terminated directly in box-type lugs.
 - 2. Solid conductors (when allowed for lighting and receptacle circuits) of #10 and #12 may be directly terminated to screw terminals.
 - 3. For any power, control, or signal wire terminating on screw type terminals; provide spade or ring tongue type terminations.
 - 4. Stranded control conductors may be directly terminated in box type terminals at control panels. Insulated terminals shall be used also on all stranded instrumentation wiring.
 - 5. Terminal boxes shall be provided at instrument cable splices. If cable is buried or in raceway below grade at splice, an instrument stand shall be provided as specified with terminal box mounted approximately 3 feet above grade.
 - 6. Special instrumentation cables shall be terminated in accordance with the recommendations of the manufacturer of the equipment and subject to review by the Engineer.
 - 7. No splices shall be used in power, control and/or signal wiring. The wiring shall be continuous from point-to-point. Extending existing cables will not be allowed except were shown on the drawings.
- B. Terminal Marking:
 - 1. All terminals in instrument and relay compartments, motor control centers, in control panels, instrument panels, field panels and control stations, as well as connections to mechanical equipment shall have reference number and letter in accordance with the following:
 - h = Control power hot (usually 120v or 24v)
 - n = neutral
 - g = ground
 - c = control (use if none of the above letters apply)
 - p = power (usually 480v)
 - s = signal (usually 4-20ma or 1-5v) (use if none of the above letters apply)
 - B = DC + and –
 - 2. PLC input or output (S=slot number and I = card input number: for example, slot 3 input 7 = 3-07).
- C. Wire Marking:
 - 1. All power and control conductors shall be tagged; including conductors in instrument and relay compartments of motor control centers, in control panels, instrument panels, field panels and control stations, as well as connections to

- mechanical equipment, shall be tagged at each end with legible, permanently coded tight fitting wire-marking sleeve showing the complete wire designation.
2. Wire marking lettering shall be bold and type written.
 3. Wiring within a single enclosure shall be marked with the basic wire and terminal number at each end.
 4. Control and signal wires that interface to PLC I/O shall be marked so that the number relates to the PLC slot and I/O number – this is the same number as the terminal number.
 5. All field wiring shall have wire labels at each end. The labels shall be marked with the output terminal number at the original equipment (control panel, MCP, RCP, LCP or MCC) or remote device terminal # (if applicable).
 6. For wire that terminates in at a control panel at both ends or a control panel and an MCC, the priority for the numbering shall be as follows:
 1. MCP
 2. RCP
 3. MCC
 4. LCP

END OF SECTION

ATTACHMENT: ELECTRICAL SYSTEM TEST REPORTS

ELECTRICAL SYSTEM
DESCRIPTION DATA

SERVICE DESCRIPTION:

nominal voltage, phase to phase
phase to neutral - single or three phase-
number of conductors

SERVICE CONDUCTORS:

phase size and insulation type
neutral size and insulation type
ground size and insulation type

SERVICE DISCONNECT DESCRIPTION:

circuit breaker or disconnect switch
size (amps)
fuse (amps)

MEASURED CONDITIONS		DATA
Operating Load Voltage	Volts	Vab_____Vbc_____Vca_____
		Van_____Vbn_____Vcn_____
Operating Load Feeder Current	Amps	Ia_____Ib_____Ic_____
Conductor Insulation Resistance (record the indicated measurement for each of the following circuits:)	Megohms	a-b_____b-c_____c-a_____
	Megohms	a-g_____b-g_____c-g_____
1.	Service Feeder	
2.	Pump Feeders	

26 05 00 - MOTOR DATA AND TEST REPORT

EQUIPMENT NAME AND NUMBER: _____

EQUIPMENT SPECIFICATION SECTION: _____

MOTOR STARTER LOCATION _____

CONTRACTORS REPRESENTATIVE _____ DATE _____

MOTOR NAMEPLATE DATA

MFR Name/Model No. _____
Voltage/Phase/HP _____
FLA/LRA _____
Service Factor _____
Efficiency Index (or percent) _____
NEMA Design _____
Code Letter _____
Insulation Type _____
Temperature Rise _____
Ambient Temperature _____
RPM _____
Enclosure _____
Thermal Trip Setting _____
Space HTR: Watts/Volts _____
Other Data _____

MOTOR STARTER INFORMATION

Manufacturer/Type _____
Overload Heater No _____

* RECORDED FULL LOAD DATA VOLTS A-G _____ B-G _____ C-G _____
FULL LOAD OPERATING VOLTAGE VOLTS A-B _____ B-C _____ C-A _____
FULL LOAD OPERATING CURRENT AMPS A _____ B _____ C _____

INSULATION RESISTANCE MEGOHMS A-G _____ B-G _____ C-G _____
(deenergized)

MOTOR CIRCUIT RESISTANCE OHMS A-B _____ B-C _____ C-A _____

* VOLTAGE & CURRENT READINGS SHALL BE TAKEN AT THE CLOSEST
ACCESSIBLE POINT TO THE LOAD

END OF SECTION

SECTION 26_27_13

UTILITY POWER SERVICE AND METERING*

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. Work consists of installation of new service 120/240V, 1 phase, 60 amps.

1.02 SCHEDULING WORK WITH THE UTILITY COMPANY

- A. The Contractor shall be responsible for all scheduling and coordination with the utility company. The Contractor shall coordinate and schedule power outages, power service for operation and construction, and power service as may be required by the facility prior to Certificate of Occupancy.
- B. The Contractor shall make all necessary applications for service with the utility, and shall notify the owner in writing of any obligations that the owner must fulfill for service to be started, installed, or modified.

1.03 CONTRACTOR/UTILITY INTERFACE RESPONSIBILITIES

- A. The requirements shown on the drawings for power service to the site is general in nature and the Contractor shall meet all of the serving utilities requirement to deliver a complete electric service.
- B. During design contact was made with PSE.
- C. The contractor shall coordinate and provide all required work and equipment to provide service to the site as required by the serving utility.
- D. Utility Charges:
 - 1. All direct serving utility charges for the permanent service will be paid for by the Owner and shall not be included in the Contractor's bid price.
 - 2. The Contractor is required to coordinate work with the power utility and other utilities as necessary for installation of new service and service entrance requirements.
 - 3. Utility charges, including all costs associated with utility meter and/or transformer changes, for permanent service shall be paid directly by the Owner. Contractor is to submit Utility invoices for such work, without markup, to the Owner.

1.04 QUALITY ASSURANCE

- A. Comply with all serving utility company standards and requirements.

1.05 STANDARDS AND CODES

- A. Work involving service installation shall be done in accordance with the serving utility's standards and the National Electric Code.

- B. Service equipment shall be listed and labeled by UL as "suitable for use as service equipment".

1.06 SUBMITTALS

- A. In conformance with the submittal requirements of Section 26_00_00 - Electrical General, submit catalog data showing material information and conformance with specifications on the following.
- B. Prior to submittal to the Engineer, the Contractor shall submit all equipment and construction details (such as size, mounting height, materials, location of equipment, etc.) to the serving utility for verification of compliance to the utility's requirements.

PART 2 PRODUCTS

2.01 METER ENCLOSURE

- A. Meter enclosure shall be as required to meet the requirements of the serving utility. Installation shall be per the utility requirements.
- B. Contractor shall coordinate with Utility. on type of metering required and shall provide all labor and material necessary to meet Utility requirements.
- C. Provide disconnect ahead of the meter if required by the Utility. Disconnect shall meet Utility standards.

2.02 C.T. ENCLOSURE

- A. Utility metering CT enclosures shall meet all requirements of the serving Utility and shall be located as shown on the drawings.

PART 3 EXECUTION

3.01 GROUND ELECTRODE SYSTEM

- A. The grounded conductor and ground bus shall be connected to the grounding electrode system, via the grounding electrode conductor as indicated on system one-line diagram.
- B. The system shall be as indicated in Article 250-81 of the National Electrical Code (NEC).

3.02 SERVICE COMPONENTS

- A. Install all service components (service raceways, transformers, primary raceways, conductors, handholes, vaults, etc.) in accordance with the utility requirements, the NEC, and Section 26_05_00 - Miscellaneous Electrical.
- B. Provide service handholes and vaults as required by the serving utility even if not shown on the plans.

3.03 UTILITY REQUIREMENT VERIFICATION

- A. The contractor shall coordinate and submit all equipment, materials, etc. related to the utility work to the serving utility to verify conformance to the Utility's requirements for service. The contractor shall also submit any plans for the installation of the primary and secondary service for approval by the Utility prior to excavation. Any discrepancy between the Utility requirements and the Contract documents shall be brought to the immediate attention of the Owner & Engineer.

- B. Contractor shall obtain permit and obtain L&I inspection prior to connection of power.

END OF SECTION

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SECTION 31_00_00

EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Loosening, excavating, filling, grading, borrow, hauling, preparing subgrade, compacting in final location, wetting and drying, and operations pertaining to site grading for buildings, basins, reservoirs, boxes, roads, and other facilities.
 - 2. Backfilling and compacting under and around structures.
 - 3. Subgrade preparation shall include preparing roadbeds, curbs, curbs and gutters, sidewalks, driveway approaches, driveways, or any other permanent hard surface improvement for base material or final surfacing.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. Standard Specifications for Highway Bridges.
- B. ASTM International (ASTM):
 - 1. D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³).
 - 2. D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- C. Washington State Department of Transportation (WSDOT):
 - 1. Standard Specifications for Road, Bridge, and Municipal Construction, most recent edition.

1.03 DEFINITIONS

- A. Backfill adjacent to structure: Backfill within volume bounded by the exterior surfaces of structure, the surface of undisturbed soil in the excavation around structure, and finish grade around structure.
- B. Excavation: Consists of loosening, removing, loading, transporting, depositing, and compacting in final location, wet and dry materials, necessary to be removed for purposes of construction of structures, ditches, grading, roads, and such other purposes as are indicated on the Drawings.

1.04 SUBMITTALS

- A. Copy of Property Owner's Agreement allowing placement of surplus soil material on their property.
- B. Excavation plan.

- C. Testing lab: Submit Contractor's proposed testing laboratory capabilities and equipment.
- D. Test reports:
 - 1. Submit certified test reports of tests specified to be performed by the Contractor.

1.05 QUALITY ASSURANCE

- A. Initial compaction demonstration:
 - 1. Adequacy of compaction equipment and procedures: Demonstrate adequacy of compaction equipment and procedures before exceeding any of following amounts of earthwork quantities:
 - a. 50 cubic yards of backfill adjacent to structures.
 - b. 100 cubic yards of embankment work.
 - c. 100 cubic yards of fill.
 - d. 50 cubic yards of roadway base material.
 - e. 100 cubic yards of road fill.
 - 2. Compaction sequence requirements: Until specified degree of compaction on previously specified amounts of earthwork is achieved, do not perform additional earthwork of the same kind.
 - 3. After satisfactory conclusion of initial compaction demonstration and at any time during construction, provide confirmation tests as specified under "FIELD QUALITY CONTROL."

1.06 SEQUENCING AND SCHEDULING

- A. Schedule earthwork operations to meet requirements specified in this Section for excavation and uses of excavated material.
- B. If necessary, stockpile excavated material in order to use it at specified locations.
- C. Excavation, backfilling, and filling: Perform excavation, backfilling, and filling during construction in manner and sequence that provides drainage at all times.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Performance requirements:
 - 1. Where mud or other soft or unstable material is encountered, remove such material and refill space with stabilization material. Wrap stabilization material with stabilization fabric.
 - 2. Obtain acceptable import material from other sources if surplus obtained within Project site does not conform to specified requirements or are not sufficient in quantity.
 - 3. No extra compensation will be made for hauling of fill materials nor for water required for compaction.

2.02 MATERIALS

- A. Water for compacting: Use water from source acceptable to Engineer.

- B. Soil and rock materials:
 - 1. General:
 - a. Provide Gravel Back Fill for Pipe Bedding, Structural Fill/Backfill, Sand, Crushed Surfacing Top Course, and Crushed Surfacing Base Course where specified or indicated on the Drawings.
 - 2. Gravel Back Fill for Pipe Bedding: As specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
 - 3. Structural Fill/Backfill: As specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
 - 4. Sand: As specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
 - 5. Crushed Surfacing Top Course (CSTC): As specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
 - 6. Crushed Surfacing Base Course (CSBC): As specified in Section 31_05_15 - Soils and Aggregates for Earthwork.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions:
 - 1. Character and quantity of material:
 - a. Verify character and quantity of rock, gravel, sand, silt, water, and other inorganic or organic materials to be encountered in work to be performed.
 - b. Determine gradation, shrinkage, and swelling of soil, and suitability of material for use intended in work to be performed.
 - c. Determine quantity of material, and cost thereof, required for construction of backfills, cuts, embankments, excavations, fills, and roadway fills, whether from onsite excavations or imported materials. Include in cost of work to be performed.
 - d. Include wasting of excess material, if required, in cost of work to be performed.

3.02 PREPARATION

- A. Backfills:
 - 1. After clearing and excavation are completed, scarify entire areas that underlie backfills or structures to a depth of 6 inches and until surface is free of ruts, hummocks, and other features that would prevent uniform compaction by equipment to be used.
 - 2. Recompact scarified areas to density specified before placing backfill material or concrete.
 - 3. If foundation areas have soft soils, do not scarify the top 6 inches prior to compaction. Remove loose material using hand equipment or with a flat-edged backhoe bucket. Do not remold and weaken the remaining soil by operating heavy equipment on final bottom elevation of excavation.
 - 4. Do not place backfill against walls until:
 - a. Walls have been cast full height of structure and concrete has reached the specified strength.
 - b. Connecting slabs and beams have been cast, and concrete has reached the specified strength.

5. Prior to backfilling:
 - a. Remove forms.
 - b. Clean trash and debris from the excavation site.
6. After inspection of foundation, walls, and pipes, place backfill symmetrically around structures to prevent eccentric loading of structures.

B. Fills:

1. After clearing is completed, scarify entire areas that underlie fill sections or structures to a depth of 6 inches and until surface is free of ruts, hummocks, and other features that would prevent uniform compaction by equipment to be used.
2. Recompact scarified areas to density specified for compacted fills before placing of fill material or concrete.

3.03 INSTALLATION

A. General:

1. Dispose of excavated materials that are not required or are unsuitable for fill and backfill in lawful manner.
2. Dispose of surplus material on private property only when written permission agreement is furnished by owner of property. Submit copies of such agreements.
3. Rocks, broken concrete, or other solid materials larger than 4 inches in greatest dimension: Remove from project site at no additional cost to the Owner.
4. Stabilization of subgrade: Provide materials used, or perform work required, to stabilize subgrade so it can withstand loads that may be placed upon it by Contractor's equipment.

B. Compaction:

1. Provide specified compaction for backfills, cuts, embankments, fills, roadway fills, and other earthwork.
2. Perform confirmation tests to verify and confirm that work has complied, and is complying at all times, with compaction requirements specified in this Section for initial compaction demonstration and field quality control testing.
3. In-place density of compacted backfills, cuts, embankments, fills, and roadway fills determined in accordance with ASTM D1556, or with ASTM D6938.
4. Maximum density, laboratory compaction: Soil maximum density and optimum water content when tested in accordance with ASTM D1557.
5. To prevent damage to structures due to backfilling operations, place backfill with equipment that does not exceed AASHTO Standard Specifications for Highway Bridges, H-20 vehicle loading, within a distance from the face of the structure of not less than 1/2 the depth of backfill. The depth of backfill is the distance between the level being compacted and the bottom of the excavation. Outside this distance, heavier compaction equipment may be used.
6. Compact to percentage of maximum density as follows:
 - a. Backfill adjacent to structures: 95 percent.
 - b. Backfilling voids: 95 percent.
 - c. Other areas: 95 percent.
 - d. Under present and future structures: 95 percent.
 - e. Under roadways, parking and storage areas, curbs, and sidewalks: 95 percent.

- f. Upper 6 inches of cuts: 95 percent.
- g. Fills: 95 percent.

C. Excavation:

- 1. **Blasting: Not permitted.**
- 2. Excavations for trenching: As specified in Section 31_23_35 - Trenching.
- 3. Excavations for structures:
 - a. Provide excavations conforming to dimensions and elevations indicated on the Drawings for each structure.
 - b. After clearing is complete, excavate for the structure, down to the elevation indicated on the Drawings. Unless directed by Engineer, do not carry excavations below elevation indicated on the Drawings.
 - c. Where soil is encountered having unsuitable bearing value, Engineer may direct in writing that excavation be carried to elevations below those indicated on the Drawings.
 - d. Where excavations are made below elevations indicated on the Drawings, adjust elevations of excavations to elevation indicated on the drawings with CSBC, Structural Fill/Backfill, Suitable Native Material, or Controlled Low-Strength Material.
 - e. Excavation width:
 - 1) Extend excavations at least **3 feet** clear from walls and foundations of structures to allow for placing and removal of forms, installation of services, and inspection.
 - 2) Do not undercut slopes.
 - f. Difficulty of excavation: No extra compensation will be made for removal of rock or any other material due to difficulty of excavation.
- 4. Necessary over excavation:
 - a. Where it becomes necessary to excavate beyond normal lines of excavation in order to remove boulders or other interfering objects, backfill voids remaining after removal as specified in backfilling of voids below, or as acceptable to the Engineer.
 - b. Backfill voids with material acceptable to the Engineer:
 - 1) With acceptance of the Engineer, backfill with one of the following:
 - a) CSBC.
 - b) Structural Fill/Backfill.
 - c) Suitable Native Material.
 - d) Controlled Low-Strength Material (CLSM).

D. Hauling:

- 1. General:
 - a. The Contactor shall follow WSDOT Standard Specs 2-04 – Hauling for any activities related to hauling.
 - b. The following section shall be supplemented with the following:
 - 1) 2-04.1 – Description:
 - a) In reference to the term “haul” as used in Section 2-04 and Section 2-09.3(1)D of the WSDOT Standard Specifications, all costs and expense involved in haul will be considered incidental and no additional compensation will be made.

- E. Materials for backfills, embankments, fills, and roadway fills:
1. General:
 - a. Obtain import material from other sources if surplus materials from cuts and excavations obtained from within Project site do not conform to specified requirements or are not sufficient in quantity for construction of Project.
 2. Backfills:
 - a. Backfill adjacent to structures, slabs, or walls: Structural Fill/Backfill, or CLSM, unless otherwise specified or indicated on the Drawings.
 - b. Backfill material under concrete structures: CSBC material unless otherwise indicated on the Drawings.
 - c. Extend backfill in any area under concrete structures from undisturbed soil or rock to the bottom crushed surface base course material layer.
 3. Roadway fills: Structural Fill/Backfill as indicated on the Drawings.
- F. Placement:
1. General:
 - a. Lines and grades:
 - 1) Construct backfills, fills, and road fills, at locations and to lines and grades.
 - 2) Overbuild permanent fill slopes by at least 1 foot and then cut to final grade to provide adequate compaction of the remaining fill.
 2. Backfills:
 - a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
 - b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
 - c. Defective compacted backfills: Remove and recompact.
 3. Fills:
 - a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
 - b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
 - c. Defective compacted fills: Remove and recompact.
 4. Roadway fills:
 - a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
 - b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
 - c. Defective compacted roadway fills: Remove and recompact.
- G. Confirmation tests:
1. Contractor's responsibilities:
 - a. Adequacy of compaction equipment and procedures:
 - 1) Demonstrate adequacy of compaction equipment and procedures.
 - 2) At each test location include tests for each type or class of backfill from bedding to finish grade.
 - b. Compaction sequence requirements:
 - 1) Do not perform additional earthwork of the same kind until specified degree of compaction has been demonstrated.
 - c. Cost of confirmation tests: Paid for by the Contractor.

- d. Qualifications of Contractor's testing laboratory: Acceptable to Engineer.
 - e. Copies of confirmation test reports: Submit promptly to the Engineer.
2. Frequency of compaction testing: testing shall place at 10-foot intervals prior to the covering of each lift. Testing shall be representative of the total backfilled area and the Engineer can require additional tests as needed to confirm the proper compaction has been achieved.

H. Tolerances:

1. Finish grading of backfills, cuts, embankments, fills, and roadway fills:
 - a. Perform fine grading under concrete structures such that finish surfaces are never above the grade or cross section and are never more than 0.10 feet below.
 - b. Provide finish surface for areas outside of structures that are within 0.10 feet of grade or cross section.
2. Unlined channels and basins:
 - a. In both cut and fill, and levee and access road side slopes in cut: Vertical tolerance of none above and 3 inches below grade on bottom and side slopes.
 - b. On top surface of levee and access road in both cut and fill, and levee and access road side slopes in fill: Vertical tolerance of none below and 3 inches above grade.
3. Areas which are not under structures, concrete, asphalt, roads, pavements, sidewalks, dikes, and similar facilities:
 - a. Provide finish graded surfaces of either undisturbed soil, or cohesive material not less than 6 inches deep.
 - b. Intent of proceeding is to avoid sandy or gravelly areas.
4. Finish grading of surfaces:
 - a. Reasonably smooth, compacted, and free from irregular surface changes.
 - b. Provide degree of finish that is ordinarily obtainable from blade grader operations, except as otherwise specified.
 - c. Uniformly grade areas that are not under concrete.
 - d. Finish ditches and gutters so that they drain readily.

3.04 ADJUSTING

- A. Finish grades of excavations, backfills, and fills:
 1. Repair and reestablish grades to required elevations and slopes due to any settlement or erosion that may occur from action of the elements or any other cause prior to final acceptance.

3.05 PROTECTION

- A. Finish grades of backfills, cuts, excavations, and fills:
 1. Protect newly graded areas from erosion and deterioration by action of the elements.
- B. Ditches and gutters:
 1. Maintain ditches and gutters free from detrimental quantities of debris that might inhibit drainage until final acceptance.
- C. Cleanup:
 1. The Contractor shall take every possible precaution to preserve the existing improvements to remain. All damages to existing improvements from the

Contractor's operation, whether within the road right of way or in private property, shall be the sole responsibility of the Contractor to remedy. All such areas shall be restored to their preconstruction equivalent to the satisfaction of the Owner.

2. All areas disturbed by the Contractor shall be smoothed, finished, cleaned, and dressed to appear uniform in all respects in accordance with Section 2-11 of the WSDOT Standard Specifications.

END OF SECTION

SECTION 31_05_15

SOILS AND AGGREGATES FOR EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Material requirements for soils and aggregates.

1.02 REFERENCES

- A. Washington State Department of Transportation (WSDOT):
 - 1. Standard Specifications for Road, Bridge, and Municipal Construction, most recent edition.
- B. ASTM International (ASTM):
 - 1. D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.

1.03 SUBMITTALS

- A. Product data:
 - 1. Material source.
 - 2. Gradation.
 - 3. Testing data.
- B. Quality control for aggregate base course:
 - 1. Test reports: Reports for tests required by Sections of Standard Specifications.
 - 2. Certificates of Compliance: Certificates as required by Sections of Standard Specifications.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Storage and protection: Protect from segregation and excessive moisture during delivery, storage, and handling.

PART 2 PRODUCTS

2.01 MATERIALS - GENERAL

- A. General:
 - 1. Provide material having maximum particle size not exceeding 4 inches and that is free of trash, lumber, debris, leaves, grass, roots, stumps, and other organic matter.
 - 2. Materials derived from processing demolished or removed asphalt concrete are not acceptable.
 - 3. Comply with soil and aggregate material requirements in the Standard Specifications., unless specified otherwise.

- B. Aggregates for foundation material, pipe zone bedding, pipe zone backfill, and trench backfill shall meet the requirements of Section 9-03.9(3) "Crushed Surfacing" of the WSDOT Standard Specifications.
- C. Structural Fill/Backfill:
 - 1. Material for structural fill/backfill shall be select import material consist of sand and gravel complying with Standard Specifications for Gravel Borrow Section 9-03.14 (1) with fines content limited to less than 5 percent based on the portion passing the 3/4 inch sieve.
- D. Suitable Native Material:
 - 1. Sound, on-site earthen material meeting the gradation for Structural Fill/Backfill.
- E. Sand:
 - 1. Granular material free from wood bark and other materials.
 - 2. Comply with Standard Specifications 9-03.13(1).
- F. Crushed Surfacing Top Course/Crushed Surfacing Base Course:
 - 1. Manufactured from ledge rock, talus, or gravel.
 - 2. Uniform in quality and substantially free from wood, roots, bark, and other extraneous material.
 - 3. Comply with Standard Specification 9-03.9(3).
- G. Controlled Low Strength Material (CLSM) shall be per Section 31_23_24 - Controlled Low Strength Material (CLSM).
- H. Vault Construction:
 - 1. Structural fill:
 - a. Meet Standard Specifications 9-03.14(3) or otherwise recommended by the vault manufacturer.
 - b. Shall be backfilled within 2 feet of the ground surface in paved areas where compaction to 95 percent of maximum dry density (MDD) per ASTM D1557.
 - c. Shall be placed in 8 to 12-inch loose lifts, or a thickness to achieve required compaction.
 - d. If placed greater than 2 feet below the ground surface shall be compacted to at least 90 percent of the MDD.
 - 2. On-Site Material Will Not Be Reused As Structural Fill.

2.02 SOURCE QUALITY CONTROL

- A. Source quality control testing shall be as required by the Standard Specifications.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 31_23_24

CONTROLLED LOW STRENGTH MATERIAL (CLSM)

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Controlled low strength material (CLSM), also known as "flowable fill."

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 1. 229R - Report on Controlled Low-Strength Materials.
 2. 301 - Specifications for Structural Concrete.
- B. ASTM International (ASTM):
 1. C94 - Standard Specification for Ready Mix Concrete.
 2. C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
 3. C150 - Standard Specification for Portland Cement.
 4. C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 5. C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 6. D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³(2,700 kN-m/m³)).
 7. D4832 - Standard Test Method of Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
 8. D5971 - Standard Practice for Sampling Freshly Mixed Controlled Low Strength Material.
 9. D6023 - Standard Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material.

1.03 SUBMITTALS

- A. Product data: Submit data completely describing materials in the mix and demonstrating compliance with the requirements of this Section:
 1. Cement: Mill tests. Indicate alkali content representative of each shipment.
 2. Fly ash: Identify source and type of fly ash.
 3. Water: Identify source and quality if not from a municipal treatment source.
 4. Admixtures: Manufacturer's product data indicating suitability for use in CLSM mixes and recommended dosage rates.
 5. Aggregate:
 - a. Submit source, type, and sieve analyses.
 - b. Resubmit at any time there is a significant change in grading of materials.
- B. Mix design:
 1. Submit full details, including mix design calculations for mix proposed for use.
 2. Trial batch test data:
 - a. Submit data for each test cylinder.
 - b. Submit data that identifies mix and slump for each test cylinder.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Store or stockpile cement, fly ash, and aggregate in accordance with ACI 301.
- B. Store admixtures in accordance with the manufacturer's recommendations.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Mixture of portland cement, water, pozzolan, fine aggregate and admixtures, proportioned in accordance with the recommendations of ACI 229 to produce a homogeneous mixture that is flowable, that will readily work into corners and angles; that will not segregate in the plastic state; and that is self-compacting at the time of placement without the use of mechanical vibration.
- B. Performance requirements:
 - 1. Air content, total calculated in accordance with ASTM D6023: Not less than 8.0 percent, nor greater than 12.0 percent.
 - 2. Compressive strength, measured in accordance with ASTM D4832 at 28 days: Not less than 50 pounds per square inch, nor greater than 150 pounds per square inch.
 - 3. Wet density: Not greater than 132 pounds per cubic foot.
 - 4. Slump, measured in accordance with ASTM C143 at the point of placement: Greater than 9 inches and that allows CLSM to flow freely and to be self-compacting during placement.

2.02 MATERIALS

- A. Cement:
 - 1. Portland cement in accordance with ASTM C150, Type I or Type II.
 - 2. Having total alkali content not more than 0.60 percent.
- B. Fly ash: Class C or Class F fly ash in accordance with ASTM C618.
- C. Water:
 - 1. Potable water: Clean and free from oil and deleterious amounts of alkali, acid, organic matter, or other substances.
- D. Admixtures: Products of a single manufacturer, specifically manufactured or recommended by that manufacturer for use in CLSM:
 - 1. Air entraining admixture: In accordance with ASTM C260.
- E. Aggregate:
 - 1. Non-expansive, non-reactive, inert natural sand conforming to the following requirements:
 - a. Not more than 12 percent passing a No. 200 sieve.
 - b. No plastic fines present.
 - c. Including pea gravel no larger than 3/8 inch.

2.03 MIXES

- A. See System Description for performance requirements of the plastic and hardened mix.

2.04 SOURCE QUALITY CONTROL

- A. Trial batch:
 - 1. After mix design has been accepted by Engineer, have trial batch of the accepted mix design prepared by testing laboratory acceptable to Engineer.
 - 2. Prepare trial batches using the specific cement, fly ash, admixtures, aggregates, and water proposed for the Work.
 - 3. Prepare trial batch with quantity sufficient to determine slump, workability, and consistency; and to provide test cylinders as indicated in this Section.
- B. Trial batch testing:
 - 1. Determine slump in accordance with ASTM C143, with the following modifications:
 - a. Do not rod the concrete material.
 - b. Place material in slump cone in one semi-continuous filling operation, slightly overfill, tap lightly, strike off, and then measure and record slump.
 - 2. Prepare and test trial batch specimens in accordance with ASTM D4832, with the following modifications:
 - a. Provide cylindrical test specimens, each 6-inches in diameter by 12-inch high.
 - b. Provide a minimum of 8 cylinders for testing of each trial batch.
 - c. Fill the molds to overflowing and tap sides lightly to settle the mix.
 - d. Do not rod the mix for consolidation in the cylinder.
 - e. Strike off the excess material.
 - 3. Place test cylinders in a moist curing room. Exercise caution in moving and transporting the cylinders since they are fragile and will withstand only minimal bumping, banging, or jolting without damage.
 - 4. Do not remove the test cylinder from mold until that cylinder is to be capped and tested:
 - a. Perform the capping carefully to prevent premature fractures.
 - b. Do not perform initial compression test until the cylinders reach a minimum age of 3 days.
 - 5. Provide compressive strength tests:
 - a. Test 4 test cylinders at 7 days after casting, and another 4 cylinders at 28 days after casting.
 - b. The compression strength of the 4 test cylinders tested at 28 days shall be equal to or greater than the minimum required compression strength, but shall not exceed maximum compression strength.
- C. If the trial batch tests do not meet the Specifications for strength or density, revise and re-submit the mix design, prepare additional trial batch(es), and complete additional trial batch tests. Repeat until an acceptable trial batch is that conforms to the Specifications is produced:
 - 1. All the trial batches and acceptability of materials shall be paid by the Contractor.
 - 2. After acceptance, do not change the mix design without submitting a new mix design, trial batches, and test information.

PART 3 EXECUTION

3.01 PREPARATION

- A. Do not place CLSM until preparation and condition of surfaces receiving the fill have been observed and accepted by the Engineer.
- B. Remove debris foreign matter, and standing or running water from excavations and areas receiving CLSM before placement.

3.02 INSTALLATION

- A. Pipes and trenches:
 - 1. Install cellular concrete as indicated on the Drawings and specified.
 - 2. Where CLSM is placed around and over pipes, secure pipes in place, or place CLSM in lifts to prevent pipe flotation.
 - 3. Where CLSM is placed in long, open trenches, confine material using bulkheads of sandbags, earth dams, or stiffer concrete at open ends of placement.

3.03 MEASURING, BATCHING, MIXING AND TRANSPORTING

- A. Measure, batch, mix and transport CLSM in accordance with the requirements of ASTM C94 and this Section.
- B. Mix until there is uniform distribution of materials.
- C. Discharge mixer completely prior to recharging.
- D. After trial batch testing and mix acceptance, maintain slump during construction within plus or minus 1 inch of the design slump.

3.04 PLACING

- A. Place controlled low strength material by method that preserves the quality of the material in terms of compressive strength and density.
- B. Maintain fluid properties of the mix during placement:
 - 1. At point of placement, provide material that flows easily around, beneath, or through walls, pipes, conduits, or other structures.
 - 2. Do not place CLSM that has partially hardened or that has been contaminated by foreign materials.
 - 3. Handle and place CLSM using methods that minimize segregation of the mix.
 - 4. Deposit mix as near its final position as possible to avoid segregation due to rehandling or flowing.
 - 5. Contain and confine mix while it is fluid. Design containment structures and bracing at walls and forms to withstand lateral pressures of wet mix.
- C. Lifts:
 - 1. Limit lift heights of CLSM placed against structures and other facilities that could be damaged due to the pressure from the CLSM, to the lesser of 3 feet or the lift height.

2. Do not place another lift of CLSM until the last lift of CLSM has set and gained sufficient strength to prevent additional lateral load against the forms or structure due to the weight of the next lift of CLSM.
- D. Water conditions:
1. Do not place CLSM in standing or flowing water.
 2. Do not permit water to flow over the surface of freshly placed or un-hardened CLSM.
 3. Do not submerge CLSM in water within 24 hours after placement.
- E. Manage CLSM bleed water:
1. Grade top surface of CLSM to drain away from the fill.
 2. Provide side containment that permits bleed water to drain to a contained management area away from the fill.

3.05 CURING AND PROTECTION

- A. Curing:
1. Prior to and during curing, install barriers to prevent equipment or personnel from falling into or becoming entrapped in CLSM.
- B. Protect CLSM from:
1. Damage from the elements.
 2. Damage of any nature during surrounding construction operations.
 3. Freezing: Do not use salt, manure, or other chemicals to provide protection from cold temperatures.

3.06 FIELD QUALITY CONTROL

- A. Provide quality control over the Work of this Section as specified in Section 01_45_00 - Quality Control and Section 01_45_17 - Contractor Quality Control Plan and as specified in this Section.
- B. General:
1. Engineer inspection and acceptance required prior to placement.
 2. Make provisions for and furnish all material for the test specimens.

3.07 FIELD QUALITY ASSURANCE

- A. Provide quality control over the work of this Section as specified in Section 01_45_00 - Quality Control and Section 01_45_17 - Contractor Quality Control Plan.
- B. Field inspections:
1. Engineer shall provide on-site inspection for the Work of this Section.
 2. Advise Engineer of readiness to proceed at least 24 hours prior to each placement of CLSM.
 3. Required inspections:
 - a. Engineer will observe the prepared areas. Do not place CLSM until Engineer has observed and accepted preparations.
 4. Record of inspections.

- C. Field sampling and testing:
1. During construction, Contractor shall provide sampling and testing to determine whether the CLSM, as produced and placed, complies with the requirements specified.
 2. Sample CLSM for testing in accordance with ASTM D5971.
 3. Required tests:
 - a. Air content: Prepare sample and test in accordance with ASTM D6023.
 - b. Compressive strength: Prepare and test cylinder specimens in accordance with ASTM D4832:
 - 1) Prepare 6-inch diameter by 12-inch high specimens for testing:
 - a) Provide one set of specimens for each 150 cubic yards of CLSM placed, but not less than 1 set for each half day's placement.
 - b) Prepare and test not less than 3 cylinders for each set.
 - c) Place CLSM in the molds in accordance with ASTM D4832. Do not rod or otherwise consolidate the material in the mold.
 - d) In accordance with ASTM D4832 recommendations for displacing bleed water at the top of the molds and refilling the molds before covering with a lid. Do not use air-tight lids.
 - 2) Place the cylinders in a safe location away from construction activities:
 - a) Protect cylinders from bumping and impact.
 - b) Maintain temperature surrounding cylinders between 60 and 80 degrees Fahrenheit until delivery to the laboratory for testing.
 - c) After the first day, surround molds with a high humidity environment by covering with wet burlap, or equivalent highly absorptive material. Maintain saturation of the cover. Do not sprinkle water directly on the cylinders.
 - 3) After 4 days, place the cylinders in a protective container for transport to the laboratory for testing:
 - a) Exercise caution in moving and transporting the cylinders since they are fragile and will withstand only minimal bumping, banging, or jolting without damage.
 - b) Transport container may be a box with a Styrofoam or similar lining that will limit jarring and bumping of the cylinders.
 - 4) Upon receipt at the testing laboratory, place test cylinders in a moist curing room until dates for testing.
 - 5) Do not remove test cylinders from molds until the day that cylinders is to be capped and tested.
 - 6) Cap and test for compressive strength in accordance with ASTM D4832:
 - a) Do not perform initial compression test until the cylinders reach an age of at least 4 days.
 - b) Test 1 cylinder at 7 days and 2 at 28 days.
 - 7) Compressive strength of the cylinders tested at 28 days shall be equal to or greater than the minimum required compression strength, but shall not exceed maximum compression strength specified.

3.08 NON-CONFORMING WORK

- A. When testing or observation indicates CLSM with properties outside the specified and accepted range, Engineer will issue instructions regarding disposition of nonconforming materials.

- B. Engineer may:
 - 1. Reject CLSM represented by those test specimens and require its removal and replacement.
 - 2. Require modification of the mix design to provide CLSM with the properties specified.

- C. Make such modifications at no additional expense to the Owner and with no adjustment to the schedule.

END OF SECTION

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SECTION 31_23_35

TRENCHING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Trench excavation and trench backfill for pipelines, vaults, and appurtenances.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method.
 - 2. D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³).
- B. Washington State Department of Transportation (WSDOT):
 - 1. Standard Specifications for Road, Bridge, and Municipal Construction, most recent edition.

1.03 SUBMITTALS

- A. As specified in Section 01_33_00 - Submittal Procedures.
- B. Product data on soils and aggregates.
 - 1. Material source.
 - 2. Gradation.
 - 3. Test data to demonstrate compliance with requirements as specified in this Section.
- C. Samples:
 - 1. Provide 50-pound sample of materials when requested by the Engineer.
- D. Confirmation testing:
 - 1. Certification of Contractor's testing laboratory.
 - 2. Record copy report for tests performed by Contractor's testing laboratory.

1.04 DEFINITIONS

- A. Backfill: Material placed in trench above the pipe embedment zone.
- B. Bedding: Material placed under, around, and over pipes or ducts in trenches.
- C. Fine grading: bedding material placed directly below pipes or ducts to provide support at the bottom of the trench and to bring those elements to required grades and elevations.

- D. Pipe foundation: Stabilization material placed at the bottom of trench to provide support when the trench bottom is not firm, dry or uniform.
- E. Pipe embedment zone: Includes bedding, fine grading, and haunch zone.
- F. Haunch zone: Material placed below and beside the pipe up to the pipe springline.
- G. Pipe springline: A horizontal reference line located at mid-height, or halfway point, of a circular conduit, pipe, or tunnel. It is the maximum horizontal dimension or diameter of a circular conduit, pipe, or tunnel.
- H. Flexible pipe: Includes steel, ductile iron, thermoplastics such as polyvinyl chloride (PVC) and high-density polyethylene (HDPE), thermosetting plastics such as fiberglass-reinforced polymer (FRP), bar-wrapped concrete cylinder pipe, and corrugated steel pipes.
- I. Haunch zone: Material placed below and beside the pipe up to the pipe springline.
- J. Lift: A layer of soil or aggregate material, measured before compaction.
- K. Maximum density, laboratory compaction: Soil maximum density and optimum water content when tested in accordance with ASTM D1557.
- L. Maximum density, field compaction: Soil density and water content when tested in accordance with ASTM D1556.
- M. Pavement section: Includes pavement plus underlying courses such as base course and subgrade.
- N. Pipe embedment zone: Includes bedding, fine grading, and haunch zone.
- O. Pipe foundation: Material placed at the bottom of trench to provide support.

PART 2 PRODUCTS

2.01 MATERIALS

- A. As specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
- B. As specified in Section 03_30_01 - Cast-in-Place Concrete.
- C. Controlled low-strength material: As specified in Section 31_23_24 - Controlled Low Strength Material (CLSM).

PART 3 EXECUTION

3.01 PREPARATION

- A. Stabilize excavations as specified in Section 31_50_00 - Excavation Support and Protection.

3.02 TRENCH EXCAVATION

- A. Excavate bottom of trench to depth required. The bottom to the trench excavation shall be firm and dry. The depth of trenching for the water main shall be a minimum of 3 feet of cover for 8-inch or smaller water main and 3.5 feet of cover for 12-inch water main or larger, unless superseded by graphically showing more or less cover in the plan and profile drawings. Additionally, the Contractor shall pothole in accordance with WSDOT Section 7-09.3(7) such that grade changes can be made so that hydrants can be installed without using vertical bends on the hydrant run to cross existing utilities.
- B. Areas of new fill or embankment:
 - 1. Prior to laying pipes or electrical service, place fill and compact as specified to not less than 2 feet above top of pipe, conduit, or duct bank.
 - 2. Excavate through fill for pipe trench.
- C. Trench shall be excavated to a sufficient width to allow for pipe installation, compaction equipment, and shoring when necessary.

Buried Pipe Or Accessory	Minimum Trench Width	Maximum Trench Width
Nominal Pipe Diameter: 4 inch to 24 inch	OD + 18 inches	See Detail PD-3 on DWG TW-02
Nominal Pipe Diameter: Greater than 24 inch	OD + 24 inches	See Detail PD-3 on DWG TW-02
Vaults, valves, or other accessories	12 inches between outer surface and trench side or shoring	Not applicable

- D. Potable water pipe and appurtenances:
 - 1. Lay in trenches separate from those used for sewers and recycled water.
 - 2. Unless otherwise specified or indicated on the Drawings, lay in trenches having cover of not less than 3 feet below surface of ground located at distance of not less than 10 feet clear horizontally from any parallel sewer and 1 foot clear vertically above any parallel sewer.
- E. At road crossings or existing driveways:
 - 1. Provide notification, vehicular access, and traffic control as required by permits and special conditions.
 - 2. Provide temporary asphalt or plating for traffic or access at the end of each work day unless approved in writing by Engineer.
 - 3. If unexpected utility conflicts or changed site conditions require trenchless technologies or temporary bridges, immediately notify the Engineer in writing. Approval is required before proceeding with construction.
 - 4. When trench width at top of pipe is increased beyond width specified in this Section because of soil conditions, safety requirements, or other reasons, Engineer approval for remedy is required without additional cost to Owner:
 - a. Remedy may include upgrade laying conditions or install stronger pipe designed in accordance with Specifications.

3.03 TRENCH BACKFILL - GENERAL

- A. Trench area terminology and locations as indicated on the Drawings.
- B. Place material, except CLSM and concrete, in maximum 6 inch lifts, measured before compaction.
- C. Backfilling of manhole excavation: Conform to backfilling requirements for trenches as specified in this Section.
- D. Backfilled trench surfaces shall be patched at the end of each week with a two (2) inch minimum compacted depth of temporary hot mix asphalt and maintained level with the existing grade until final surface restoration is completed. More frequent trench patching may be necessary if roadway surface conditions change and will be at the discretion of the City inspector. The trench surface shall be kept reasonably smooth, free from ruts and potholes, and suitable for normal traffic flow. Temporary trench patches must be continually maintained by the Contractor at his expense. Continuing maintenance of patching shall be incidental to the work

3.04 PIPE FOUNDATION

- A. Provide trench bottom with firm, dry, uniform bearing surface at the grade indicated on the Drawings.
- B. Excess excavation below elevation indicated on the Drawings will require installation of pipe foundation material to bring the trench bottom back to the elevation indicated on the Drawings at no additional cost to Owner.
- C. If bottom of trench excavation consists of soil:
 - 1. Scarify bottom of trench to a depth of 6 inches below the grade indicated on the Drawings.
 - 2. Materials and placement:
 - a. Recompact scarified material to 95 percent of maximum density.
- D. If bottom of trench excavation consists of rock or any material that, by reason of its hardness, cannot be excavated to provide uniform bearing surface:
 - 1. Remove such rock or other material to a depth of not less than 4 inches below pipe embedment zone.
 - 2. Materials:
 - a. CLSM.
 - b. Class C concrete.
- E. If bottom of trench excavation consists of mud or other soft unstable material:
 - 1. Remove such unacceptable material to a depth of not less than 18 inches below pipe embedment zone.
 - 2. Material and placement.

3.05 PIPE EMBEDMENT ZONE

- A. Pipe displacement:
 - 1. Take necessary precautions in placement and compaction of bedding material to prevent displacement of piping.

2. In event there is movement or floating of the piping, re-excavate, re-lay, and backfill the pipe.
- B. Fine grading:
1. Place 6-inches of approved haunch zone bedding material from the trench bottom to the bottom of the pipe or duct to provide support at the bottom of the trench and to bring those elements to required line and grade.
- C. Depressions for joints or couplings:
1. Excavate holes in the fine grading material at the bottom of the trench.
 2. Provide holes of sufficient width to provide ample room for grouting, banding, or welding as necessary for making joints and to ensure that pipe rests upon prepared trench bottom and not supported by any portion of the joint.
- D. Flexible pipe:
1. Pipe embedment zone:
 - a. Compacted to a depth above pipe: 12-inch minimum.
 - b. Materials and placement:
 - 1) Gravel backfill for pipe zone bedding as specified in Section 31_05_15 - Soils and Aggregates.

3.06 BACKFILL

- A. Trenches:
1. Materials and placement:
 - a. Gravel Back Fill for Pipe Bedding as specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
 - b. Structural Fill/Backfill as specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
 - c. Suitable Native Material as specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
 - d. Crushed Surfacing Top Course (CSTC) as specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
 - e. Crushed Surfacing Base Course (CSBC) as specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
- B. Trenches below or within 10 feet of the outside perimeter of structures:
1. Backfill to underside of structural fill below structure, as specified in Section 31_00_00 - Earthwork.
 2. Materials and placement:
 - a. Aggregate base course compacted to 95 percent of maximum density.
 - b. CLSM.
- C. Trenches in roadways and paved areas:
1. Backfill trench to underside of pavement.
 2. Materials and placement:
 - a. Gravel Back Fill for Pipe Bedding as specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
 - b. Structural Fill/Backfill as specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
 - c. Crushed Surfacing Top Course (CSTC) as specified in Section 31_05_15 - Soils and Aggregates for Earthwork.

- d. Crushed Surfacing Base Course (CSBC) as specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
 - e. CLSM.
- D. Trenches in areas outside the improved section of roadways:
- 1. Backfill to finished grade to underside of topsoil layer.
 - 2. Materials and placement:
 - a. Suitable Native Material as specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
- E. Trenches under existing intersecting pipes, duct banks, or conduits larger than 3 inches in diameter:
- 1. Backfill from above top of new pipe embedment zone to springline of intersecting pipe or conduit:
 - a. Extend backfill at least 2 feet on either side of intersecting pipe or conduit to ensure backfill material remains in place while other backfill is being placed.
 - b. Materials and placement:
 - 1) CLSM, unless otherwise indicated on the Drawings.
 - 2. Backfill remainder of trench:
 - a. Materials and placement:
 - 1) CLSM.
 - 2) Class C concrete.

3.07 EXCESS MATERIAL

- A. Remove excess excavated material from the Project site as specified in Section 31_00_00 - Earthwork.

3.08 FIELD QUALITY CONTROL

- A. Provide field quality control for the Work as specified in Section 01_45_00 - Quality Control.
- B. Confirmation tests: As specified in Section 31_00_00 - Earthwork:
 - 1. Minimum frequency of confirmation testing:
 - a. At each test location include tests for each type or class of backfill from bedding to finished grade.
 - b. For trenches: 1 location every 200 linear feet.
 - c. In open fields: 2 locations every 1,000 linear feet or 1 location every 200 cubic yards.
 - d. Along dirt or gravel road or off traveled right-of-way: 1 location at every 500 linear feet.
 - e. Crossing paved roads: 1 location at each crossing.
 - f. Under pavement cuts or within 2 feet of pavement edges: 1 location every 400 linear feet.
- C. Compliance tests:
 - 1. Make periodic compliance tests to verify that compaction is meeting requirements as specified in this Section.
 - 2. Perform remedial work if compaction test fails to meet specified requirements using one of the following methods:
 - a. Remove and replace backfill at the proper density.

- b. Other means acceptable to the Engineer.
 - 3. Retesting:
 - a. Costs of retesting: Contractor is responsible for the costs of retesting required to confirm and verify that remedial work has brought compaction within specified requirements.
 - b. Contractor's confirmation tests during performance of remedial work:
 - 1) Performance: Perform tests in manner acceptable to the Engineer.
 - 2) Frequency: Double amount specified for initial confirmation tests.
 - 4. Retesting:
 - a. Costs of retesting: Contractor is responsible for the costs of retesting required to confirm and verify that remedial work has brought compaction within specified requirements.
 - b. Contractor's confirmation tests during performance of remedial work:
 - 1) Performance: Perform tests in manner acceptable to the Engineer.
 - 2) Frequency: Double amount specified for initial confirmation tests.
- D. Piping system testing:
- 1. As specified in Section 40_05_00.09 - Piping Systems Testing.

END OF SECTION

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SECTION 31_32_18.02

FILTER FABRIC

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Nonwoven filter fabric.

1.02 REFERENCES

- A. ASTM International (ASTM):
 1. D4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
 2. D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 3. D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
 4. D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 5. D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile.
 6. D5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
 7. D6241 - Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.

1.03 DEFINITIONS

- A. Filter fabric: Nonwoven geotextile fabric manufactured from polypropylene fibers.

1.04 SUBMITTALS

- A. Product data.
- B. Samples.
- C. Quality control submittals:
 1. Certificates of Compliance.
 2. Manufacturer's Instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Storage and protection:
 1. Furnish filter fabric in protective covers capable of protecting the fabric from ultraviolet rays, abrasion, and water.

1.06 PROJECT CONDITIONS

- A. Take field measurements to determine the lengths and dimensions of the surfaces to receive the fabric.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. One of the following or equal:
1. Propex, Geotex 401.
 2. Ten Cate Geosynthetics, Mirafi 140N.

2.02 MATERIAL REQUIREMENTS

- A. Physical properties: Meet the following minimum requirements:

Property ⁽¹⁾	Test Method	Unit	Requirements ⁽¹⁾
Minimum Weight	ASTM D5261	oz	4.0
Grab Tensile Strength	ASTM D4632	lbs	100
Grab Elongation	ASTM D4632	%	50
Trapezoid Tear Strength	ASTM D4533	lbs	50
CBR Puncture Resistance	ASTM D6241	lbs	300
UV Resistance (strength retained at 500 hrs)	ASTM D4355	%	70
Apparent Opening Size (AOS)	ASTM D4751	US sieve	70
Permittivity	ASTM D4491	sec ⁻¹	1.7
Flow Rate	ASTM D4491	gpm/ft ²	130

(1) Minimum average roll values.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions: Verify that conditions are satisfactory for the installation of filter fabric.

3.02 PREPARATION

- A. Surface preparation:
1. During grading operations, take care not to disturb the subgrade.
 2. This may require use of lightweight dozers for low strength soils such as saturated, cohesionless, or low cohesion soils.
- B. Prior to placement of fabric: Prepare surface to smooth condition free of debris, depressions, or obstructions that may damage the fabric.

3.03 INSTALLATION

- A. Follow manufacturer's installation instructions and as complimented in this Section.
- B. Place the filter fabric smoothly without folds or wrinkles.

- C. Use special care when placing the filter in contact with the soil so that no void spaces occur between the filter and the prepared surface.
- D. Overlap the parallel rolls and ends of rolls a minimum of 24 inches and not less than manufacturer's instructions.
- E. Do not drag filter fabric across subgrade.
- F. Make overlaps at ends of rolls in the direction of the aggregate placement with the previous roll on top.
- G. Use lightweight dozers if necessary. Do not allow equipment directly on filter fabric.

3.04 FIELD QUALITY CONTROL

- A. Inspection:
 - 1. Before covering, the condition of the fabric will be observed by the Engineer to determine that no holes or rips exist in the fabric.
 - 2. Repair all holes and rips by placing a new layer of fabric extending beyond the defect in all directions a distance equal to the minimum overlap required for adjacent rolls.

END OF SECTION

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SECTION 31_50_00

EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements for designing, providing, maintaining, and removing excavation support and protection.

1.02 REFERENCES

- A. American Society of Civil Engineers (ASCE):
 - 1. Guidelines of Engineering Practice for Braced and Tied-Back Excavations.
- B. Department of the Navy Naval Facilities Engineering Command (NAVFAC):
 - 1. Design Manual 7.2 - Foundations and Earth Structures.
 - 2. Design Manual 7.3 - Soil Dynamics and Special Design Aspects.
- C. Washington Administrative Code:
 - 1. WAC 296-155 Part N.
- D. USS Steel Sheet Piling Design Manual.

1.03 DEFINITIONS

- A. General Engineering Design Practice: General engineering design practice in area of the Project, performed in accordance with recent engineering literature on subject of shoring and stability of excavations.
- B. Shoring: A temporary structural system, as described in WAC 296-155 Part N, designed to support vertical faces, or nearly vertical faces, of soil or rock for purposes of excavation. Shoring includes internally braced sheet piling, slurry walls, and other similar shoring systems. Sloping of the soil is not shoring.

1.04 SUBMITTALS

- A. Shop drawings and calculations:
 - 1. Calculations for different load, support, and other conditions that occur during the sequence of installation of shoring, construction of facilities protected by shoring, and sequence of removal of shoring.
 - 2. Sketches showing the condition at various stages of installation and removal of shoring.
 - 3. Show on plan shoring, structures, pipelines, and other improvements located near shoring.
 - 4. When utilities penetrate shoring, show location of penetrations on elevation of sides of shoring.
 - 5. Show details for ground support and sealing around utility penetrations.
 - 6. Indicate method used for installing driven shoring.

- B. Control points and schedule of measurements:
 - 1. Submit location and details of control points and method and schedule of measurements:
 - a. Establish and monitor control points for horizontal and/or vertical displacement of soils being supported by the shoring and structures within the zone of influence of the excavation. Provide at least two control points in to monitor soil displacement at each excavation and at least two control points to monitor structure displacement at each excavation where a structure is within the zone of influence of the excavation. The zone of influence shall be any structure that exists with the soils extending up at a 1:1 slope from the bottom of the excavation to the surrounding grade.
 - 2. Survey data.
- C. Detailed sequence of installation and removal of shoring:
 - 1. Consider effects of ground settlement in sequence of installation and removal of shoring.
 - 2. Provide sketches showing conditions at various stages in sequence of installation and removal of shoring.
- D. Submit submittals for excavation support and protection as complete package and include items required in this Section:
 - 1. Incomplete submittals will not be reviewed and will be returned for resubmittal as complete package.

1.05 SEQUENCING

- A. Do not begin construction of any shoring or excavation operations until:
 - 1. Submittals for shoring and dewatering have been accepted.
 - 2. Control points as specified in this Section and on existing structures and other improvements as indicated on the Drawings have been established and surveyed to document initial elevations and locations.
 - 3. Materials necessary for installation are on site.
- B. Submit submittals minimum of 30 days prior to scheduled date to begin excavation work.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

- A. Where general engineering design practice is specified, provide drawings and calculations that are performed and signed by civil or structural engineer registered in Washington State:
 - 1. Clearly disclose assumptions made, criteria followed, and stress values used for materials being used in design calculations.
 - 2. Submit list of references acceptable to Engineer that substantiating appropriateness of design assumptions, criteria, and stress values.

B. Design requirements:

1. General:

- a. For trench excavations 4 feet or more in depth and for trenches less than 4 feet in depth when there is potential for cave-in:
 - 1) Perform design pursuant to general engineering design practice.
 - 2) Conform to the requirements of WAC 296-155 Part N.
 - b. Dewatering:
 - 1) Do not lower groundwater outside of shoring more than 1 foot.
 - 2) Recharge groundwater outside shoring to limit groundwater draw down outside of shoring to amount specified above.
 - c. The calculated minimum depth of penetration of sheet pile shoring below bottom of excavation shall be increased not less than 30 percent if full value of allowable passive pressure is used in design.
 - d. Maximum height of cantilever shoring above bottom of excavation shall not exceed 15 feet. Use braced shoring when height of shoring above bottom of excavation exceeds 15 feet.
 - e. The location of point of fixity for shoring shall not be less than half calculated minimum embedment depth below bottom of excavation.
 - f. Generally acceptable references for design of shoring and excavations are as follows:
 - 1) ASCE Guidelines of Engineering Practice for Braced and Tied-Back Excavations.
 - 2) NAVFAC Design Manual 7.2.
 - 3) NAVFAC Design Manual 7.3.
 - 4) USS Steel Sheet Piling Design Manual.
 - g. Maximum total deflection of shoring at any point on shoring shall not be more than 1/4inch.
2. Set inside face of shoring back from structure not less than greater of following:
- a. 5 feet from face of wall.
 - b. 2 foot 6 inches from edge of foundation.
 - c. Depth of excavation below bottom of foundation.

C. Performance requirements:

1. General:

- a. Support faces of excavations and protect structures and improvements in vicinity of excavations from damage and loss of function due to settlement or movement of soils, alterations in ground water level caused by such excavations, and related operations.
 - b. Specified provisions:
 - 1) Complement, but do not substitute or diminish, obligations of Contractor for furnishing of safe place of work pursuant to provisions of the WAC 296-155 and its subsequent amendments and regulations and for protection of Work, structures, and other improvements.
 - 2) Represent minimum requirement for:
 - a) Number and types of means needed to maintain soil stability.
 - b) Strength of such required means.
 - c) Methods and frequency of maintenance and observation of means used for maintaining soil stability.
2. Provide safe and stable excavations by means of sheeting, shoring, bracing, sloping, and other means and procedures, such as draining and recharging

- groundwater and routing and disposing of surface runoff, required to maintain stability of soils and rock.
3. Provide support for trench excavations for protection of workers from hazard of caving ground.
 4. Provide shoring:
 - a. Where, as result of excavation work and analysis performed pursuant to general engineering design practice, as defined in this Section:
 - 1) Excavated face or surrounding soil mass may be subject to slides, caving, or other types of failures.
 - 2) Stability and integrity of structures and other improvements may be compromised by settlement or movement of soils, or changes in soil load on structures and other improvements.
 - b. For excavations or trenches 4 feet and deeper.
 - c. For excavations or trenches less than 4 feet in depth, when there is potential for cave-in.
 5. For safe and stable excavations, use appropriate design, construction, and maintenance procedures to minimize settlement of supported ground and to prevent damage to structures and other improvements, including:
 - a. Using stiff shoring systems.
 - b. Following appropriate construction sequence.
 - c. Using shoring system that is tight enough to prevent soil loss through the shoring.
 - d. Using shoring system that extends far enough below bottom of excavation to prevent piping, heave, or flow of soil under shoring.
 - e. Providing surface runoff routing and discharge away from excavations.
 - f. Where dewatering inside shoring is necessary, recharge groundwater outside shoring as necessary to prevent settlement in area surrounding shored excavation.
 - g. Not applying shoring loads to existing structures and other improvements.
 - h. Not changing existing soil loading on existing structures and other improvements.
 - i. Provide welded steel packing between soil retaining members such as sheet piles and wales and similar members.

PART 3 EXECUTION

3.01 CONSTRUCTION

- A. Installation of shoring:
 1. Install means for providing safe and stable excavations as indicated in submittals.
- B. Removal of shoring:
 1. Except for concrete encased soldier piles, slurry walls, and similar shoring systems, remove shoring by completion of Work.
 2. Select shoring system and method of removal, which will minimize soil that sticks to shoring from creating voids and causing settlement.
 3. To prevent settlement caused by pulling shoring, fill voids with pressure injected grout:
 - a. Inject grout starting at bottom of void and progressively fill void to grade.

- b. Minimize length of shoring removed ahead of grouting operation and limit time void is left ungrouted to prevent void from closing up before being grouted.
4. Pressure preservative treated wood lagging may be left in place if acceptable to Engineer.

C. Maintenance:

1. Where loss of soil occurs, plug gap in shoring and replace lost soil with fill material acceptable to Engineer.
2. Where measurements and observations indicate possibility of failure or excessive movement of excavation support, determined in accordance with general engineering design practice, take appropriate action immediately.

END OF SECTION

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SECTION 32_01_15

PAVEMENT RESTORATION AND REHABILITATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Resurfacing roads and paved surfaces in which surface is removed or damaged by installation of new work.

1.02 SUBMITTALS

- A. Mix designs:
 - 1. Prior to placement of asphalt concrete, submit full details, including design and calculations for the asphalt concrete mix proposed.
 - 2. Submit gradation of aggregate base.
 - 3. Submit proposed mix design of portland cement concrete.

1.03 REFERENCES

- A. Washington State Department of Transportation (WSDOT):
 - 1. Standard Specifications for Road, Bridge, and Municipal Construction, most recent edition.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Performance requirements:
 - 1. Limiting dimensions:
 - a. The City shall determine the exact lengths and dimensions of such roads, pavements, parking areas, and walks that will require removal and replacement.
 - b. Join existing surfaces to terminals of new surfacing in smooth juncture.

2.02 MATERIALS

- A. Aggregate base course: As specified in Section 31_05_15 - Soil and for Earthwork.
- B. Asphalt pavement: As specified in Section 32_12_15 - Asphaltic Concrete Paving.
- C. Portland cement concrete replacement material: Class A concrete as specified in Section 03_30_01 - Cast-in-Place Concrete.

2.03 EQUIPMENT

- A. Roads, pavements, parking areas, and walks:
 - 1. Equipment requirements: Good condition, capable of performing work intended in satisfactory manner.

2.04 ACCESSORIES

- A. Material for painting asphalt concrete pavement: Tack coat as specified in Section 32_12_15 - Asphaltic Concrete Paving.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Aggregate surface removal replacement:
 - 1. When trench cut is in aggregate surfaced areas, replace aggregate base course material with material matching existing material compacted to 95 percent of its maximum density.

- B. Pavement removal and temporary asphalt replacement:
 - 1. Install temporary asphalt pavement or first course of permanent pavement replacement immediately following backfilling and compaction of trenches that have been cut through existing pavement.
 - 2. Except as otherwise provided, maintain this temporary pavement in safe and reasonably smooth condition until required permanent pavement is installed.
 - 3. Remove and dispose of temporary paving from project site.
 - 4. Where longitudinal trench is partly in pavement, replace pavement to original pavement edge, on a straight line, parallel to centerline of roadway.
 - 5. Where no part of longitudinal trench is in pavement, surfacing replacement shall only be required where existing surfacing materials have been removed.
 - 6. Existing asphalt concrete pavement shall be removed and replaced at the locations shown in the Drawings and where designated by the Engineer. This work shall be performed where shown in the Drawings in accordance with Section 2-02.3(3) of the WSDOT Standard Specifications and these Technical Specifications.
 - 7. Removal shall be accomplished by milling along the boundaries of the area to be removed. Milling shall be accomplished as previously specified with a self-propelled machine capable of cutting to a twelve (12) inch depth and approved by the Engineer. The use of pneumatic hammers or punches will not be permitted.
 - 8. Care shall be taken in removing the pavement not to damage any of the existing pavement that is to remain in place. Any remaining asphalt concrete pavement damaged due to the Contractor's operations shall be replaced by the Contractor, to the satisfaction of the Engineer at the Contractor's expense.
 - 9. Removal shall be accomplished using an asphalt milling attachment that grinds the asphalt pavement in place as approved by the Engineer. The Contractor shall submit a proposed plan to the Engineer for approval for asphalt removal. The plan shall identify the equipment and methods to be used for the removal and disposal of the pavement. The pulverized pavement may be used as trench backfill material in the area above the pipe zone and twelve (12) inches below the asphalt path as approved by the Engineer.

- C. Asphalt pavement replacement:
1. Replace asphalt pavement to same thickness as adjacent pavement and match as nearly as possible adjacent pavement in texture, unless otherwise indicated on the Drawings.
 2. Cut existing asphalt pavements to be removed for trenches or other underground construction by wheel cutter, clay spade, or other device capable of making neat, reasonably straight and smooth cut without damaging adjacent pavement. Cutting device operation shall be subject to acceptance of Engineer.
 3. Cut and trim existing pavement after placement of required aggregate base course and just prior to placement of asphalt concrete for pavement replacement, and paint trimmed edges with material for painting asphalt concrete pavement immediately prior to constructing new abutting asphalt pavements. No extra payment will be made for these items, and costs incurred in performing this work shall be incidental to pipe laying or pavement replacement.
 4. Conform replacement of asphalt pavement to contour of original pavement.
- D. Cement Concrete Pavement Removal:
1. Existing cement concrete pavement shall be removed and replaced at the locations shown in the Plans and where designated by the Engineer. This work shall be performed where shown in the Plans in accordance with Section 2-02.3(3) of the WSDOT Standard Specifications and these Technical Specifications.
 2. Removal shall be accomplished by saw cutting along the boundaries of the area to be removed. Sawcutting shall be accomplished with a self-propelled machine capable of cutting to a twelve (12) inch depth and approved by the Engineer. The use of pneumatic hammers or punches will not be permitted.
 3. Care shall be taken in removing the pavement not to damage any of the existing pavement that is to remain in place. Any remaining cement concrete pavement damaged due to the Contractor's operations shall be replaced by the Contractor, to the satisfaction of the Engineer at the Contractor's expense.
- E. Portland cement concrete pavement replacement:
1. Where trenches lie within portland cement concrete section of streets, alleys, sidewalks, and similar concrete construction, saw cut such concrete (to a depth of not less than 1-1/2 inches) to neat, vertical, true lines in such manner adjoining surfaces are not damaged.
 2. Place portland cement concrete replacement material to dimension as indicated on the Drawings.
 3. Provide expansion joints that match existing.
 4. Before placing replacement concrete, thoroughly clean edges of existing pavement and wash with neat cement and water.
 5. Surface finish: Wood float finish.
- F. Asphalt pavements:
1. Trim existing asphalt pavements which are to be matched by pavement widening or pavement extension to neat true line with straight vertical edges free from irregularities with saw specifically designed for this purpose. Minimum allowable depth of cut shall be 1-1/2 inches.
 2. Cut and trim existing pavement after placement of required aggregate base course and just prior to placement of asphalt concrete for pavement widening

or extension, and paint trimmed edges with material for painting asphalt concrete pavement immediately prior to constructing new abutting asphalt concrete pavements.

3. No extra payment will be made for these items and costs incurred in performing this work shall be incidental to widening or pavement extension.

G. Removing and/or Resetting of Miscellaneous Items:

1. The Contractor shall remove and/or reset miscellaneous items as described in the Drawings and as necessary to satisfactorily complete the work. The items requiring resetting shall be protected from damage during removal as far as is practical. If in the opinion of the Engineer an item requires replacement due to the Contractor's negligence it shall be replaced in kind at the Contractor's expense.

H. Monuments:

1. Any monuments disturbed during Construction shall be reset by the Contractor, at the Contractor's expense. The Contractor is responsible for notifying the Surveyor prior to disturbing any monuments so that the proper survey ties and paperwork can be completed prior to disturbance.

3.02 FIELD QUALITY CONTROL

A. Tests:

1. Asphalt concrete as specified in Section 32_12_15 - Asphaltic Concrete Paving.
2. Concrete as specified in Section 03_30_01 - Cast-in-Place Concrete.

B. Inspection:

1. Asphalt concrete:
 - a. Lay 10-foot straightedge parallel to centerline of trench when the trenches run parallel to street, and across pavement replacement when trench crosses street at angle.
 - b. Remove and correct any deviation in cut pavement replacement greater than 1/4 inch in 10 feet.
2. Portland cement concrete replacement pavement:
 - a. Lay 10-foot straightedge either across pavement replacement or longitudinal with centerline of gutter or ditch.
 - b. Remove and correct any deviation in cut pavement replacement greater than 1/4 inch in 10 feet.

END OF SECTION

SECTION 32_12_15

ASPHALTIC CONCRETE PAVING

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for one or more layers of plant-mixed hot mix asphalt (HMA) on prepared foundations or base in accordance with this Section and in conformity with the lines, grades, thicknesses, and typical cross-sections indicated in the Drawings.
- B. This Section includes references to portions of the Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT Standard Specifications) and Washington State Department of Transportation Standard Plans (WSDOT Standard Plans). Such references are to define the technical standards to be met for this Section; only the technical standards are referenced. Administrative provisions (such as Measurement and Payment) of the WSDOT Standard Specifications or WSDOT Standard Plans shall not apply to this Contract in any instance.
- C. References to Engineer in the WSDOT Standard Specifications shall mean Project Representative.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the embedded standard referenced herein. In case of conflict between the requirements of this Section and those of a listed document, the requirements of this Section shall prevail:
 - 1. Washington State Department of Transportation:
 - a. Washington State Department of Transportation Standard Specifications For Road, Bridge, and Municipal Construction.
 - b. Washington State Department of Transportation Standard Plans For Municipal Construction.
 - c. WSDOT Standard Operating Procedure (SOP) 732.
 - d. WSDOT Materials Manual M 46-01.

1.03 DEFINITIONS

- A. Bituminous prime coat: Consist of application of hot bituminous material on previously prepared base course.
- B. Asphaltic concrete pavement; Hot mix asphalt (HMA).

1.04 SUBMITTALS

- A. Procedures: Section 01_33_00 - Submittal Procedures.

- B. Mix Design submittal as required per WSDOT Standard Specifications for materials in this Section.
- C. Product data and gradation for aggregate for Materials in this Section.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Asphalt concrete delivery:
 - 1. Transport the mixture from the mixing plant to the point of use in vehicles having tight bodies previously cleaned of foreign materials.
 - 2. Treat bodies as necessary to prevent material from sticking to the bodies.
 - 3. Cover each load with canvas or other suitable material of sufficient size and thickness to protect the asphalt mixture from the weather.
- B. Comply with Standard Specifications storage requirements, if applicable.

1.06 PROJECT CONDITIONS

- A. Environmental requirements:
 - 1. Asphalt concrete:
 - a. Place asphalt concrete only when surface is dry, and when atmospheric temperature in the shade is 40 degrees Fahrenheit and rising, or above 50 degrees Fahrenheit if falling.
 - b. Do not place asphalt concrete when weather is foggy or rainy or when base on which material is to be placed is in wet or frozen condition.
 - 2. Prime coat:
 - a. Do not apply prime coat when atmospheric temperature is below 60 degrees Fahrenheit.
 - b. Apply prime coat only when base course is dry or contains moisture not in excess of that which will permit uniform distribution and desired penetration.

1.07 SEQUENCING AND SCHEDULING

- A. Prime coat:
 - 1. Prior to requesting Engineer's acceptance for application, inspect area to be coated to determine its fitness to receive bituminous priming material.
 - 2. Do not begin application before area to be coated has been accepted for application by the Engineer.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

2.02 MATERIALS

- A. The grade of paving asphalt shall be Commercial HMA Class B unless otherwise directed by the Engineer.
- B. Materials for Ballasting and Crushed Surfacing per WSDOT Standard Specification 4-04.2.

- C. Use of Substitute Materials per WSDOT Standard Specification 5-04.2(1).
- D. Tack Coat shall be CSS-1, CSS-1h, or STE-1 emulsified asphalt per WSDOT Standard Specification 9-02.1(6).
- E. Surface Sealant (Fog Seal) shall be CSS-1 or CSS-1h emulsified asphalt per WSDOT Standard Specification 9-02.1(6).
- F. Anti-Stripping Additive per WSDOT Standard Specification 9-02.4.
- G. Temporary Pavement Patch Material shall be per WSDOT Standard Specification 5-04.2 (Hot Mix).
- H. Temporary Pavement Markings per WSDOT Standard Specification 8-23.

2.03 EQUIPMENT

- A. Mixing Plant per WSDOT Standard Specifications 5-04.3(3)A.
- B. Hauling Equipment per WSDOT Standard Specification 5-04.3(3)B.
- C. Paving and Related Equipment per WSDOT Standard Specification 5-04.3(3)C.
- D. Compaction Rollers per WSDOT Standard Specification 5-04.3(3)E.
- E. Smoothness Testing Equipment per WSDOT Standard Specification 5-04.3(13):
 - 1. Equipment for Ballasting and Crushed Surfacing per WSDOT Standard Specifications 4-04.3(1).

2.04 MIXES

- A. HMA shall be composed of asphalt binder and mineral materials as may be required, mixed in the proportions specified to provide a homogeneous, stable, and workable mixture.
- B. HMA Mix Design per WSDOT Standard Specification 5-04.2(1).
- C. WSDOT Standard Specifications 5-04.2(2)A shall be supplemented with the following:
 - 1. General. Prior to the production of HMA, the Contractor shall determine a design aggregate structure and asphalt binder content in accordance with WSDOT Standard Operating Procedure 732. Once the design aggregate structure and asphalt binder content have been determined, the Contractor shall submit the HMA mix design on DOT form 350-042 demonstrating the design meets the requirements of Sections 9-03.8(2) and 9-03.8(6) of the Standard Specifications. Verification of the mix design by the Contracting Agency is not needed. The Project Engineer will determine anti-strip requirements for the HMA.
 - 2. The mix design will be the initial Job Mix Formula (JMF) for the class of mix. Any additional adjustments to the JMF will require the approval of the Project Engineer and may be made per Section 9-03.8(7) of the Standard Specifications.

3. Non-Statistical Evaluation. Non statistical acceptance will apply to all HMA not designated as Commercial HMA in the contract documents. Non statistical acceptance testing will be conducted as outlined in 5-04.3(8)A of the 2016 standard specifications.
4. Commercial Evaluation. Where Commercial HMA is allowed it can be accepted by a Manufacturer's Certificate of Compliance stating the material meets the requirements in the contract. Where HMA Commercial is used for the traveled way, a minimum of one acceptance test to verify gradation, fracture, sand equivalent, and oil content is required in addition to the Manufacturer's Certificate of Compliance.

2.05 FABRICATION / MIXING

- A. Heating of Asphalt Binder per WSDOT Standard Specification 5-04.3(3)A.
- B. HMA Mixing Process per WSDOT Standard Specification 5-04.3(6).
- C. Anti-Stripping Additive per WSDOT Standard Specification 9-02.4.

2.06 SOURCE QUALITY CONTROL

- A. As required per WSDOT Standard Specifications for testing of materials in this Section.

PART 3 EXECUTION

3.01 SUBGRADE AND BASE COURSE PREPARATION

- A. Subgrade preparation per WSDOT Standard Specification 2-06:
 1. Exception: Includes all survey and survey staking.
- B. Gravel Base per WSDOT Standard Specification 4-02.
- C. Ballast and Crushed Surfacing Course shall be placed per WSDOT Standard Specification 4-04.

3.02 PREPARATION

- A. Preparation of Street Surfaces per WSDOT Standard Specification 5-04.3(4).
- B. Utility adjustments per WSDOT Standard Specification 5-04.3(13) and 7-05.3(1).

3.03 INSTALLING

- A. Spreading and Finishing per WSDOT Standard Specification 5-04.3(7).
- B. Applying Tack Coat per WSDOT Standard Specification 5-04.3(4).
- C. HMA Compaction per WSDOT Standard Specification 5-04.3(10)A.
- D. HMA Joints per WSDOT Standard Specification 5-04.3(12).

- E. Weather Limitation per WSDOT Standard Specification 5-04.3(1).
- F. Paving and Planing Under Traffic per WSDOT Standard Specification 5-04.3(2).
- G. Crack Sealing of Pavement Surfaces per WSDOT Standard Specification 5-04.3(4)A.
- H. Surface Sealing (fog seal) of pavement surfaces per WSDOT Standard Specification 5-04.3(15).
- I. Road Approaches and sidewalks per WSDOT Standard Specification 5-04.3(16).
- J. Temporary Pavement Patching:
 - 1. Temporary Pavement Patch Material shall be in accordance with Section 2.01.
 - 2. Furnish, place and maintain a 4-inch minimum compacted thickness of Temporary Pavement Patch material over open cuts. Such temporary asphalt patching will be required where vehicular or pedestrian traffic must be accommodated and permanent pavement patching cannot be placed immediately. Trench backfill shall be compacted as specified in Section 31_23_35 - Trenching.
 - 3. Temporary Pavement Patch material shall be compacted and leveled to coincide with adjacent surfaces.
 - 4. In the event that the temporary surface subsides after the initial placement, additional Temporary Pavement Patch material shall be placed over the subsided material as necessary to maintain a surface level with existing pavement. Maintain such temporary patching in a timely manner.
 - 5. Prior to final restoration of the pavement remove the Temporary Pavement Patch material and such underlying material as may exist, clean the exposed face of the existing pavement to remain, and restore the pavement.
- K. Temporary Pavement Markings per WSDOT Standard Specifications 5-02.
- L. Thickened Edges and Berms:
 - 1. Where existing thickened edges or berms are disturbed or as directed by the Engineer, the Contractor shall reconstruct thickened edges and berms to match the existing condition, without changing any existing drainage patterns.
 - 2. Reconstruction of thickened edges, berms, and asphalt transitions will be paid for under the bid item for "Hot Mix Asphalt (HMA) Class B Permanent Trench Patch".

3.04 FIELD QUALITY CONTROL

- A. Acceptance of prepared subgrade and compaction testing per WSDOT Standard Specification 2-06.3 and 2-03.3(14).
- B. Acceptance of tack coat application method and rate per WSDOT Standard Specification 5-04.3(4).
- C. HMA Mixture Acceptance:
 - 1. Acceptance of HMA shall be as provided under nonstatistical or commercial evaluation.
 - 2. Sampling of HMA for nonstatistical evaluation will be as discussed in WSDOT Standard Specifications in Section 5-04.3(8).

3. Commercial evaluation will be used for Commercial HMA and other classes of HMA as allowed by the contract. Commercial HMA may be used for amounts of HMA less than 2500 tons in any application. Testing beyond that specified in 5-04.3(9)A, for Commercial HMA will be at the discretion of the engineer. Anti-strip additive, where required, will be verified and documented by the engineer.
- D. Aggregate Acceptance prior to mixing HMA per WSDOT Standard Specification 5-04.3(8).
 - E. The acceptance criteria for aggregate properties of sand equivalent, voids in mineral aggregate (VMA), fracture and gradation will be their conformance to the requirements of Section 9-03.8(2) the WSDOT Standard Specification.
 - F. HMA Mixture Acceptance per WSDOT Standard Specification 5-04.3(9)D.
 - G. HMA Compaction Acceptance per WSDOT Standard Specification 5-04.3(10). Surface Smoothness per WSDOT Standard Specification 5-04.3(13).

END OF SECTION

SECTION 32_90_00

LANDSCAPE RESTORATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Supplemental requirements for roadside restoration, irrigation systems, and erosion and sediment control and roadside planting.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions of the embedded standard referenced herein. In case of conflict between the requirements of this Section and those of a listed document, the requirements of this Section shall prevail:
 - 1. Washington State Department of Transportation (WSDOT):
 - a. Washington State Department of Transportation Standard Specifications For Road, Bridge, and Municipal Construction, most current edition.
 - b. Washington State Department of Transportation Standard Plans For Municipal Construction, most current edition.

1.03 CLEARING, GRUBBING, AND ROADSIDE CLEANUP

- A. The following section of 2-01 – CLEARING, GRUBBING, AND ROADSIDE CLEANUP of the WSDOT Standard Specifications shall be supplemented with the following:
 - 1. 2-01.1 – Description:
 - a. The Contractor shall not disturb or damage existing trees on the project site unless specifically identified for removal on the plans and shall contact the Engineer if there is any conflict between the Plans and field conditions. All costs of protecting existing trees from damage shall be incidental and no separate payment shall be made for this work.
 - b. Grading Around Trees: Where excavating, or filling within the branch spread of trees that are to remain, the work shall be performed as follows.
 - c. Trenching: When trenching occurs around trees to remain, the tree roots shall not be cut, but the trench shall be tunneled under or around the roots by careful hand-digging and without injury to the roots.
 - d. Raising Grades: When the existing grade at tree is below the new finished grade and fill not exceeding sixteen (16) inches is required, clean washed gravel graded from one- to two-inch size shall be placed directly around the tree trunk. The gravel shall extend out from trunk on all sides a minimum of eighteen (18) inches and finish approximately two (2) inches above the finished grade at tree. Install gravel and cover with filter fabric before any earth fill is placed. New earth fill shall not be left in contact with the trunks of any trees requiring fill.
 - e. Trees marked for preservation that are buried in fills over sixteen (16) inches deep shall have an open dry well of durable masonry (without mortar) situated at least twelve (12) inches from the tree trunk. All wells are to be properly drained. Before fills of over sixteen (16) inches are

- made upon the tree root areas, it is advisable to spread at least a six (6) inch minimum layer of broken stone or coarse gravel covered by inverted sod shall be spread to facilitate proper drainage and aeration.
- f. Lowered Grades: Existing trees in areas where the new finished grade is to be lowered, shall have regrading work done by hand to elevation as indicated. Roots as required shall be cut cleanly three (3) inches below finished grade and cuts covered with tree paint. Trees marked for preservation that are located more than six (6) inches above proposed grades shall stand on broad rounded mounds and be graded smoothly into the lower level. Exposed or broken roots shall be cut clean and covered with topsoil.
2. 2-01.2(2) – Disposal Method No. 2 – Waste Site:
 - a. No waste site has been provided for the disposal of excess or excavated materials. The Contractor shall make his or her own arrangements for obtaining wastes sites in accordance with Section 2-03.3(7)C of the Standard Specifications and these Technical Specifications. All costs involved shall be considered incidental to and included in the unit contract price for other items in this contract.

1.04 ROADSIDE RESTORATION

- A. The following sections of 8-02 – Roadside Restoration of the WSDOT Standard Specifications shall be supplemented with the following:
 1. 8-02.1 – Description:
 - a. All plant materials required by the Plans shall be plant species including plant establishment (PSIPE) per the Standard Specifications.
 2. 8-02.2 – Materials:
 - a. Refer to Section 9-14 “Erosion Control and Roadside Planting” of these Technical Specifications.
 3. 8-02.3(1) – Responsibility During Construction:
 - a. The Contractor shall locate all underground utilities (both new and existing) prior to starting work and shall not disturb or damage them. The Contractor shall promptly notify the City of any conflict between the proposed work and the obstructions. The Contractor shall be responsible for making any and all repairs for damage, at his own expense. No flushing will be allowed. At the conclusion of the landscape construction, the Contractor shall remove surplus plant materials and installation debris from the construction site. The project shall be left in a condition acceptable to the Engineer.
 4. 8-02.3(3)A – Chemical Pesticides:
 - a. No chemical herbicides will be allowed in any planting areas.
 5. 8-02.3(4)A – Soil Type A:
 - a. Topsoil Type A shall conform to Section 9-14.1(1) “Topsoil Type A” of the Technical Specifications and shall be supplied by the Contractor's approved source.
 - b. Remove all construction debris prior to placing topsoil.
 - c. Subgrade will require review and approval by the Engineer prior to the placement of topsoil. The Contractor shall submit material certification for Topsoil Type A to the Project Engineer for approval before utilizing on site.
 - d. Thoroughly scarify subgrade in tree, shrub, and ground cover areas to a minimum depth of six (6) inches. Scarified subgrade shall be inspected

- and approved by the Engineer prior to placement of topsoil. Remove all construction debris and rocks over one (1) inch in diameter prior to the placement of topsoil.
- e. Upon approval of the subgrade by Engineer, place Topsoil Type A to depth as indicated and shown on the Plans. Topsoil Type A shall be used in areas indicated for planting as shown on the Plans. Topsoil and subgrade material shall be cultivated to a depth of twelve (12) inches except in tree grate pits. Remove rocks, roots, and debris over one (1) inch in diameter. Lightly compact soil and establish a smooth and uniform finished grade that protects against obstruction to surface drainage and ponding. Materials shall be placed so that after settlement of finished grades the top of the root zone will be flush with the top of sidewalks in lawn areas. For bark mulch areas, finished grade prior to placement of bark shall be one (1) inch below top of sidewalk.
6. 8-02.3(5) – Roadside Seeding, Lawn and Planting Area Preparation:
- a. The costs of removing all excess material and debris shall be included in the force account price for Property and Landscape Restoration.
 - b. Preparation for Topsoil Installation
 - 1) After all planting and seeding areas have been brought to required subgrade, the areas shall be reviewed and approved by the Engineer. Prior to topsoil installation, they shall be cultivated to a depth of six (6) inches unless otherwise specified. Cultivation of the soil shall be done by farm disk, harrow, or other suitable equipment approved by the Engineer. This operation should be done at right angles to the natural flow of water on slopes unless otherwise directed by the Engineer. All costs and expense incurred in performing the specified work shall be included in the force account price for Property and Landscape Restoration.
 - 2) Remove all visible rocks, clods, stumps, and debris one (1) inch or larger in any dimension. Any exposed tree roots in cut slopes shall be neatly pruned at the finish subgrade and the cuts treated with an approved sealer.
 - c. Placement of Topsoil:
 - 1) Topsoil Type A shall be installed to a minimum six (6) inch compacted depth in all shrub and groundcover areas and as required to bring disturbed areas to finished grade. All hydroseeded areas shall receive minimum two (2) inch depth of Topsoil Type A, or as required to bring subgrade to finished grade. Swale seeded areas shall receive compost incorporated into the subgrade as noted on the plans, no topsoil is required.
 - d. Finish Grade of Topsoil:
 - 1) Finish grade all topsoil areas removing all rocks, sticks, and other debris one-half (1/2) inch or larger in any dimension from the topsoil surface. Rake, float, drag, roll, and perform all necessary operations to produce a firm, smooth surface without depressions and with positive drainage. Finish grades of topsoil shall be one (1) inch, or the specified depth of mulch, below walks, curbs, tops of walls, valve and junction boxes, and driveways, unless otherwise shown on plans or specified. Finish grades shall be reviewed and approved by the Engineer prior to any planting or seeding.
7. 8-02.3(7) – Layout of Planting:
- a. The Contractor shall layout plantings as directed by the Engineer.

- b. The Contractor shall place groundcover plantings starting from the perimeter of the planting area and progress to the center. Field adjustments for plant layout shall be approved by the Engineer.
- 8. 8-02.3(10) – Fertilizers:
 - a. Fertilizers shall be approved by the Engineer. Trees and shrubs shall be fertilized at a rate of nine (9) tablets per tree, three (3) tablets per 5-gallon shrub or one (1) tablet per 1-gallon shrub or groundcover. Fertilizer tablets (or Paks) shall be considered included in the project and no additional compensation will be made.
- 9. 8-02.3(11)B – Bark or Wood Chip Mulch:
 - a. Weed-free Bark Mulch shall be placed over all planting beds to a depth no less than three (3) inches. Bark Mulch shall be placed in a minimum five (5) foot diameter around trees with a one (1) inch gap between the trunk/stem and mulch such that mulch is not in direct contact with the planting. The City may require greater diameter for large-caliper trees. Thoroughly water and hose down plants with a fine spray to wash the leaves of the plants immediately after application.
- 10. 8-02.3(17) – Property Restoration:
 - a. Roadside planting for property and landscape restoration shall consist of fine grading adjacent landscaped areas, placement of additional plant materials, extra seeding or bark mulch, slope restorations, irrigation system repair or replacement, and all other work not currently identified on the Plans, as directed by the Engineer.
 - b. The Contractor is specifically reminded that unnecessary damage caused beyond the limits of clearing or construction shall be repaired in like or better condition at the Contractor’s sole expense.

1.05 IRRIGATION SYSTEMS

- A. The following sections of 8-03 – Irrigation Systems of the WSDOT Standard Specifications shall be supplemented with the following:
 - 1. 8-03.3 Construction Requirements:
 - a. All work shall be in strict conformance with the City of Mercer Island Water Standards, together with the Plans, details and manufacturer’s written information regarding recommended installation procedures.
 - b. Private irrigation systems that have been damaged during construction activities shall be repaired or replaced within five (5) working days. The Contractor shall be liable for any damage due to irrigation facilities damaged by his operations and shall repair such damaged facilities to an “equal or better than” original condition. This work will include, but not be limited to, cutting and capping existing pipe, relocating existing risers and sprinkler heads, new pipe heads and connections, and testing of the system.
 - c. Prior to disturbance of any irrigation system the Contractor shall make arrangements with the property owner to have the existing system turned on and tested. Deficiencies found shall be reported to the Engineer prior to disturbance of the existing system.
 - d. Existing systems shall be retested after modifications have been made in the presence of the Engineer. The Engineer must approve the private irrigation system modification prior to acceptance of the work.

1.06 EROSION CONTROL AND ROADSIDE PLANTING

- A. The materials for Property and Landscape Restoration shall meet the requirements of Section 9-14 of the WSDOT Standard Specifications supplemented as follows. Irrigation water shall conform to the provisions of Section 9-25.2 of the WSDOT Standard Specifications.
- B. The following sections of 9-14 – Erosion Control and Roadside Planting of the WSDOT Standard Specifications shall be supplemented with the following:
1. 9-14.1(1) – Top Soil, Type A:
 - a. Topsoil Type A shall be two-way soil mix or approved equal, with the following specifications.
 - b. Soil mix shall be a mixture of pure compost, and sand, sandy loam or silty sand. The soil shall be high in organic content and comprised of fully composted and mature organic materials. No fresh sawdust or other fresh wood by-products shall be added to extend the volume after the composting process.
 - c. Compost shall be 98 percent minimum material derived from the aerobic decomposition of recycled plant waste and/or secondary sewage treatment. It shall be free of viable weed seeds and other plant propagules and shall have a moisture content that has no visible free water or dust produced when handling the material.
 - d. Chemical/physical characteristics shall comply with the following:
 - 1) Screen Size (approx. particle size) - 7/16 inch maximum.
 - 2) Total Nitrogen - 0.25 percent minimum.
 - 3) Organic Matter - 10 percent minimum.
 - 4) pH Range - 5.5-7.5.
 - 5) Conductivity - 5 mmhos/cm maximum.
 - 6) The following are acceptable sources/products for Topsoil:
 - a) Pacific Topsoil Environmental Mix, Cedar Grove 2 Way Mix, or approved equal.
 2. 9-14.2 – Seed:
 - a. Non-Residential lawns, pastures, and vacant land may be restored with Hydroseed meeting the following requirements:
 - 1) Hydroseed Mix #1 (Master Lawn Mix) as follows, available from Grass Master, Redmond, WA (425) 867-1117, or approved equal:

Common Name	Volume Percentage
Chewing Fescue	20%
Hard Fescue	10%
Perennial Rye Grass (3 different varieties)	70%

END OF SECTION

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SECTION 33_05_00.01

COMMON WORK RESULTS FOR GENERAL PIPING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Basic materials and methods for metallic and plastic piping systems.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through 24.
 - 2. B16.47 - Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard.
- B. American Water Work Association (AWWA):
 - 1. C11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe.
 - 2. C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - 3. C151 - Ductile-Iron Pipe, Centrifugally Cast.
 - 4. C207 - Standard for Steel Pipe Flanges for Waterworks Services-Size 4 In. Through 144 In.
 - 5. C230 - Stainless-Steel Full-Encirclement Repair and Service Connection Clamps for 2 IN. Through 12 IN. Pipe.
- C. ASTM International (ASTM):
 - 1. A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
 - 2. A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - 3. A194 - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - 4. A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
 - 5. A536 - Standard Specification for Ductile Iron Castings.
 - 6. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
 - 7. B88 - Standard Specification for Seamless Copper Water Tube.
 - 8. D2000 - Standard Classification System for Rubber Products in Automotive Applications.
 - 9. D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing and Fittings.
 - 10. F37 - Standard Test Methods for Sealability of Gasket Materials.
 - 11. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements of Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
- D. NSF International (NSF):
 - 1. 61 – Drinking Water System Components – Health Effects.

1.03 DEFINITIONS

- A. Buried pipes: Pipes that are buried in the soil with or without a concrete pipe encasement.
- B. Exposed pipe: Pipes that are located above ground, or located inside a structure, supported by a structure, or cast into a concrete structure.
- C. Underground pipes: Buried pipes - see A. above.
- D. Underwater pipes: Pipes below the top of walls in basins or tanks containing water.
- E. Wet wall: A wall with water on at least 1 side.

PART 2 PRODUCTS

2.01 GENERAL

- A. Materials as specified in Section 01_60_00 - Product Requirements - Plant including special requirements for materials in contact with drinking water.

2.02 LINK TYPE SEALS

- A. Characteristics:
 - 1. Modular mechanical type, consisting of interlocking neoprene or synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening.
 - 2. Links to form a continuous rubber belt around the pipe.
 - 3. Provide a nylon polymer pressure plate with Type 316 stainless steel hardware. Isolate pressure plate from contact with wall sleeve.
 - 4. Hardware to be Type 316 stainless steel:
 - a. Provide anti-galling lubricant for threads.
- B. One of the following or equal:
 - 1. Link-Seal.
 - 2. Pipe Linx.

2.03 FLANGE BOLTS AND NUTS

- A. General:
 - 1. Washer:
 - a. Provide a washer for each nut.
 - b. Washer shall be of the same material as the nut.
 - 2. Nuts: Heavy hex-head.
 - 3. Cut and finish flange bolts to project:
 - a. Face of the bolt shall exceed face of nut by 1/16th-inch minimum.
 - b. A maximum of 1/4-inch beyond outside face of nut after assembly.
 - 4. Tap holes for cap screws or stud bolts when used.
 - 5. Lubricant for stainless steel bolts and nuts:
 - a. Chloride-free.

- b. Manufacturers: One of the following or equal:
 - 1) Huskey FG-1800 Anti-Seize.
 - 2) Weicon Anti-Seize High-Tech.
- B. For ductile iron pipe:
 - 1. On exposed pipes with pressures equal to or less than 150 pounds per square inch gauge (psig):
 - a. Bolts: ASTM A307, Grade B.
 - b. Nuts: ASTM A563, Grade A.
 - c. Bolts and Nuts: Hot-dip galvanized in accordance with ASTM F2329.
 - 2. On exposed pipes with pressures greater than 150 psig:
 - a. Bolts: ASTM A193, Grade B.
 - b. Nuts: ASTM A194, Grade 2H.
 - c. Bolts and nuts: Hot-dip galvanized in accordance with ASTM F2329.
 - 3. On underwater pipes and pipes adjacent to wet walls:
 - a. Bolts: ASTM A193, Grade B8M.
 - b. Nuts: ASTM A194, Grade 8M.
 - 4. On buried pipes:
 - a. Bolts: ASTM A193, Grade B7.
 - b. Nuts: ASTM A194, Grade 2H.
 - c. Coat with high solids epoxy and encase in 2 layers of loose polyethylene wrap in accordance with AWWA C105.
- C. Plastic pipe:
 - 1. On exposed pipes:
 - a. Bolts: ASTM A193, Grade B8M.
 - b. Nuts: ASTM A194, Grade 8M.
 - 2. On underwater pipes and pipes adjacent to wet walls:
 - a. Bolts: ASTM A193, Grade B8M.
 - b. Nuts: ASTM A194, Grade 8M.

2.04 MECHANICAL JOINTS BOLTS AND NUTS

- A. Bolts including T-Bolts and Hex Nuts:
 - 1. High strength low alloy steel in accordance with ANSI A21.11 or AWWA C111.
 - 2. Bolts for mechanical joints shall be Dresserloy or Cor-Ten high-strength, low-alloy steel conforming to ASTM A242 and A558.

2.05 GASKETS

- A. General:
 - 1. Gaskets shall be suitable for the specific fluids, pressure, and temperature conditions.
 - 2. Capable of being applied on surface of piping with cavities to provide for an improved seal with the internal piping pressure.
- B. Gaskets for flanged joints in ductile iron or steel drinking water piping meeting NSF requirements:
 - 1. Gaskets for flanged joints shall be 1/8-inch thick, cloth-inserted rubber, conforming to applicable parts of ANSI B16.21 and AWWA C207.
 - 2. Gasket material shall be free from corrosive alkali or acid ingredients and suitable for use in potable water lines.
 - 3. Gaskets shall be one-piece, full-face with holes to pass bolts.

4. Gaskets shall be 1/8-inch-thick neoprene having a durometer of 60 plus or minus 5 or 1/16 cloth inserted. The type, material, and identification mark for bolts and nuts shall be provided.
 5. Certified to NSF-61 for potable water service.
- C. Gaskets for mechanical joints in ductile iron:
1. Certified to NSF-61 when used for potable water service.
 2. SBR, NBR, or EPDM.
- D. Gaskets for push-on rubber gasket joints in ductile iron:
1. Certified to NSF-61 when used for potable water service.
 2. SBR, NBR, or EPDM.

2.06 REPAIR BANDS

- A. Design requirements:
1. In accordance with AWWA C230.
- B. Materials:
1. Shells: Type 304 stainless steel.
 2. Lugs: Removable epoxy coated ductile iron in accordance with ASTM A536.
 3. Bolts and nuts: 304 Stainless Steel with fluoropolymer coated nuts.
 4. Gaskets: Compounded for water and sewer service.
- C. Manufacturers: One of the following or equal:
1. Romac Industries, Inc.
 2. Smith-Blair Inc.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
1. Piping drawings:
 - a. Except in details, piping is indicated diagrammatically. Not every offset and fitting, or structural difficulty that may be encountered has been indicated on the Drawings. Sizes and locations are indicated on the Drawings.
 - b. Perform minor modifications to piping alignment where necessary to avoid structural, mechanical, or other type of obstructions that cannot be removed or changed:
 - 1) Modifications are intended to be of minor scope, not involving a change to the design concept or a change to the Contract Price or Contract Times.
 2. Piping alternatives:
 - a. Provide piping as specified in this Section, unless indicated on the Drawings or specified otherwise.
 - b. Alternative pipe ratings:
 - 1) Piping with greater pressure rating than specified may be substituted in lieu of specified piping without changes to the Contract Price.
 - 2) Piping of different material may not be substituted in lieu of specified piping.

- c. Valves in piping sections: Capable of withstanding specified test pressures for piping sections and fabricated with ends to fit piping.
 - d. Flanged joints: where 1 of the joining flanges is raised face type, provide a matching raised face type flange for the other joining flange.
3. Unless otherwise indicated on the Drawings, piping at pipe joints, fittings, couplings, and equipment shall be installed without rotation, angular deflection, vertical offset, or horizontal offset.

B. Wall and slab penetrations:

1. Provide sleeves for piping penetrations through aboveground masonry and concrete walls, floors, ceilings, roofs, unless specified or otherwise indicated on the Drawings.
2. For piping 1 inch in nominal diameter and larger, provide sleeves with minimum inside diameters of 1 inch plus outside diameter of piping. For piping smaller than 1 inch in nominal diameter, provide sleeve of minimum twice the outside diameter of piping:
 - a. Arrange sleeves and adjacent joints so piping can be pulled out of sleeves and replaced without disturbing the structure.
 - b. Cut ends of sleeves flush with surfaces of concrete, masonry, or plaster.
 - c. Conceal ends of sleeves with escutcheons where piping runs through floors, walls, or ceilings of finished spaces within buildings.
 - d. Seal spaces between pipes and sleeves with link-type seals when not otherwise specified or indicated on the Drawings.
3. Provide flexibility in piping connecting to structures to accommodate movement due to soil settlement and earthquakes. Provide flexibility using details indicated on the Drawings.
4. Core drilled openings:
 - a. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without acceptance by Engineer.
 - b. Determine location of reinforcing bars or other obstructions with a non-destructive indicator device.
 - c. Remove dust and debris from hole using compressed air.

C. Exposed piping:

1. Install exposed piping in straight runs parallel to the axes of structures, unless otherwise indicated on the Drawings:
 - a. Install piping runs plumb and level, unless otherwise indicated on the Drawings:
 - 1) Slope plumbing drain piping with a minimum of 1/4-inch per foot downward in the direction of flow.
2. Install exposed piping after installing equipment and after piping and fitting locations have been determined.
3. Support piping: As specified in Section 40_05_07.01 - Pipe Supports, Section 40_05_07.03 - Preformed Channel Pipe Support System, and Section 40_05_07.05 - Non-Metallic Pipe Support System:
 - a. Do not transfer pipe loads and strain to equipment.
4. In addition to the joints indicated on the Drawings, provide unions, flexible couplings, flanged joints, flanged coupling adapters, and other types of joints or means which are compatible with and suitable for the piping system, and necessary to allow ready assembly and disassembly of the piping.

5. Assemble piping without distortion or stresses caused by misalignment:
 - a. Match and properly orient flanges, unions, flexible couplings, and other connections.
 - b. Do not subject piping to bending or other undue stresses when fitting piping.
 - c. Do not correct defective orientation or alignment by distorting flanged joints or subjecting flange bolts to bending or other undue stresses.
 - d. Flange bolts, union halves, flexible connectors, and other connection elements shall slip freely into place.
 - e. Alter piping assembly to fit, when proper fit is not obtained.
 - f. Install eccentric reducers or increasers with the top horizontal for pump suction piping.

- D. Buried piping:
 1. Bury piping with minimum 3-foot cover without air traps, unless otherwise indicated on the Drawings.
 2. Where 2 similar services run parallel to each other, piping for such services may be laid in the same trench:
 - a. Lay piping with sufficient room for assembly and disassembly of joints, for thrust blocks, for other structures, and to meet separation requirements of public health authorities having jurisdiction.
 3. Laying piping:
 - a. Lay piping in finished trenches free from water or debris. Begin at the lowest point with bell ends up slope.
 - b. Place piping with top or bottom markings with markings in proper position.
 - c. Lay piping on an unyielding foundation with uniform bearing under the full length of barrels.
 - d. Where joints require external grouting, banding, or pointing, provide space under and immediately in front of the bell end of each section laid with sufficient shape and size for grouting, banding, or pointing of joints.
 - e. At the end of each day's construction, plug open ends of piping temporarily to prevent entrance of debris or animals.

- E. Venting piping under pressure:
 1. Lay piping under pressure flat or at a continuous slope without air traps, unless otherwise indicated on the Drawings.
 2. Install plug valves as air bleeder cocks at high points in piping:
 - a. Provide 1-inch plug valves for water lines, and 2-inch plug valves for sewage and sludge lines, unless otherwise indicated on the Drawings.
 3. Provide additional pipe taps with plug cocks and riser pipes along piping as required for venting during initial filling, disinfecting, and sampling.
 4. Before piping is placed into service, close plug valves and install plugs. Protect plugs and plug valves from corrosion in as specified in Section 09_96_01 – High-Performance Coatings.

- F. Restraining buried piping:
 1. Restrain piping at valves and at fittings where piping changes direction, changes sizes, and at ends:
 - a. When piping is underground, use concrete thrust blocks, mechanical restraints, or push-on restraints.
 - b. Determine thrust forces by multiplying the nominal cross-sectional area of the piping by design test pressure of the piping.

2. Provide restraints with ample size to withstand thrust forces resulting from test pressures:
 - a. During testing, provide suitable temporary restraints where piping does not require permanent restraints.
 3. Place concrete thrust blocks against undisturbed soil.
 4. Place concrete so piping joints, fittings, and other appurtenances are accessible for assembly and disassembly.
 5. Provide underground mechanical restraints where specified in the Piping Schedule.
- G. Restraining above ground piping:
1. Restrain piping at valves and at fittings where piping changes direction, changes sizes, and at ends:
 - a. When piping is aboveground or underwater, use mechanical or structural restraints.
 - b. Determine thrust forces by multiplying the nominal cross-sectional area of the piping by design test pressure of the piping.
 2. Provide restraints with ample size to withstand thrust forces resulting from test pressures:
 - a. During testing, provide suitable temporary restraints where piping does not require permanent restraints.
- H. Connections to existing piping:
1. Expose existing piping to which connections are to be made with sufficient time to permit, where necessary, field adjustments in line, grade, or fittings:
 - a. Protect domestic water/potable water supplies from contamination:
 - 1) Make connections between domestic water supply and other water systems in accordance with requirements of public health authorities.
 - 2) Provide devices approved by Owner of domestic water supply system to prevent flow from other sources into the domestic supply system.
 2. Make connections to existing piping and valves after sections of new piping to be connected have been tested and found satisfactory.
 3. Provide sleeves, flanges, nipples, couplings, adapters, and other fittings needed to install or attach new fittings to existing piping and to make connections to existing piping.
 4. For flanged connections, provide stainless steel bolts with isolation bushings and washers, and full-face flange gaskets.
- I. Connections to in-service piping:
1. As specified in Section 01_14_00 - Work Restrictions.
- J. Connections between ferrous and nonferrous metals:
1. Connect ferrous and nonferrous metal piping, tubing, and fittings with dielectric couplings especially designed for the prevention of chemical reactions between dissimilar metals.
 2. Nonferrous metals include aluminum, copper, and copper alloys.
- K. Flanged connections between dissimilar metals such as ductile iron pipe and steel pipe:
1. Provide stainless steel bolts with isolation bushings and washers, and full-face flange gaskets.

3.02 CLEANING

- A. Piping cleaning:
 - 1. Upon completion of installation, clean piping interior of foreign matter and debris.
 - 2. Perform special cleaning when required by the Contract Documents.
- B. Cleaning potable water piping:
 - 1. Flush and disinfect potable water piping as specified in Section 01_75_18 - Disinfection.
- C. Conduct pressure and leak test, as specified.

3.03 PIPING SCHEDULE

- A. As indicated on the Drawings.

END OF SECTION

SECTION 33_05_18

PRECAST CONCRETE VAULTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Precast concrete vaults.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. LRFD Bridge Design Specifications.
- B. American Concrete Institute (ACI):
 - 1. 318 - Building Code Requirements for Structural Concrete and Commentary.
- C. ASTM International (ASTM):
 - 1. C150 - Standard Specification for Portland Cement.
 - 2. C857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 - 3. C858 - Standard Specification for Underground Precast Concrete Utility Structures.
- D. Occupational Safety and Health Administration (OSHA).

1.03 SUBMITTALS

- A. General:
 - 1. Furnish submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Shop drawings:
 - 1. Show dimensions, locations, lifting inserts, reinforcement, and joints.
 - 2. Structural design calculations for vaults, signed by a licensed registered Civil or Structural Engineer licensed in the State where project is located.
- C. Manufacturer's Certification for Vaults: Written certification that the vault complies with the requirements of this Section.

1.04 QUALITY ASSURANCE

- A. Inspection:
 - 1. After installation, the Contractor shall demonstrate that vaults have been properly installed, level, with tight joints, at the correct elevations and orientations, and that the backfilling has been carried out in accordance with the Contract Documents.

PART 2 PRODUCTS

2.01 VAULTS

- A. Manufacturers: One of the following or equal:
 - 1. Oldcastle Infrastructure.
 - 2. Jensen Precast.
- B. Provide precast vaults for the size indicated on the Drawings.
- C. The minimum structural member thickness for vaults shall be 5 inches:
 - 1. Cement shall be Type 2 Portland cement in accordance with ASTM C150.
 - 2. The minimum 28-day concrete compressive strength shall be 4,000 pounds per square inch.
 - 3. All reinforcing steel shall be embedded in the concrete with a minimum clear cover as recommended by ACI 318.
- D. Design requirements: Loads on structures:
 - 1. In accordance with ASTM C857, except as modified in this Section.
 - 2. Loads at the ground surface including hatches:
 - a. "Roadway": Load from heavy, frequently repeated vehicle traffic:
 - 1) ASTM C857, Table 1, Designation A-16 (AASHTO HS20-44).
 - 3. Loads against walls. Include effects of groundwater and seismic accelerations on earth pressures:
 - a. Equivalent lateral pressure:
 - 1) Triangular distribution: 70 pounds per square foot per foot of depth (triangular distribution).
 - 2) Rectangular distribution backfill-induced live load surcharge: 240 pounds per square foot.
 - b. Surface surcharge load: In accordance with ASTM C857 A-16 wheel load if such surcharge exceeds backfill loads described in the preceding paragraph.
 - c. Groundwater effects: Include groundwater effects on lateral earth pressure and buoyancy loads using design elevation equal to the finished grade elevation:
 - 1) Use equivalent lateral pressure of 90 pounds per square foot per foot of depth (triangular distribution) for soil below the design groundwater elevation.
 - d. Seismic acceleration effects:
 - 1) As specified in Section 01_81_02 - Seismic Design Criteria.
 - 2) On opposite sides of the structure, uniform equivalent lateral pressure type distribution, with a pressure of 37.5 in pounds per square foot where it is the depth of structure.
 - 3) Adding lateral force for soil accelerating toward structure:
 - a) Direct uniform pressure distribution toward the wall, effectively increasing the static lateral soil pressure.
 - 4) Reducing lateral force for soil accelerating away from structure:
 - a) Direct inverted pressure distribution away from the wall, effectively reducing the static lateral soil pressure.
 - 4. Groundwater and flood loads, and buoyancy effects:
 - a. Include groundwater effects on lateral earth pressure loads using design elevation equal to the finished grade elevation.

- b. Buoyancy: Provide factor of safety against flotation of at least 1.20:
 - 1) If the weight of soil overlying footing projections on the structure is considered to resist flotation, use a buoyant unit weight of soil equal to not more than 40 pounds per cubic foot.
 - 2) Concrete fill may be provided in the bottom section of precast portland cement concrete structures to add weight. Submit proposed details.
- 5. Soil bearing pressure at base:
 - a. Maximum 1,500 pounds per square foot total pressure on prepared subgrade soils.
- 6. Lifting and handling loads:
 - a. Make provision in the design for the effects of loads or stresses that may be imposed on structures during fabrication, transportation, or erection.
- 7. Load combinations:
 - a. Design structures to sustain the specified loads individually or in combination.
- E. Design requirements: Structural analysis, design and detailing:
 - 1. Analyze and design structures including the effects of 2-way action ("plate action") and of load transfer around current and future openings.
 - 2. Where structures include panels designed for future removal ("knockout panels"), design structures for loads and stresses with any combination of any or all such panels in place or removed.
 - 3. Design structures in accordance with the requirements of ACI 318 and this Section.
 - 4. Provide reinforcement at all areas.
 - 5. Provide temperature and shrinkage reinforcement to equal or exceed ACI 318 requirements in all concrete sections.
 - 6. Provide minimum clear concrete cover over reinforcement at both interior and exterior faces of all members in accordance with the following:
 - a. Vaults: 2 inches.
 - 7. Reinforcement details:
 - a. Walls: For structures with wall thickness of 8 inches or less, locate a single mat of reinforcement at the center of the wall.
 - b. Slabs: For structures with slab thickness of 7 inches or less, locate a single mat of reinforcement at the center of the slab.
 - c. Structures with wall or slab thicknesses exceeding these limits shall have a reinforcement at each face of the member.
 - 8. Joints:
 - a. Provide structures with watertight joints between sections, and detailed to minimize water infiltration at duct bank and conduit penetrations.
 - b. Provide structures with non-skid, shiplap, or tongue and groove joints between sections.
- F. Design requirements: Materials:
 - 1. Portland cement concrete vaults:
 - a. In accordance with ASTM C858, except as modified in this Section.
 - b. Proportion concrete mixes to resist damage from freezing and thawing in a moist environment, and for exposure to deicing chemicals. In accordance with ACI 318 requirements for minimum specified compressive strength and air entrainment.
 - 2. Seal joints watertight with precast concrete water tight joint sealant.

- G. Where joints are designed in pre-cast concrete vaults, such joints shall be interlocking to secure proper alignment between members and prevent migration of soil through the joint. Structural sections at joints shall be sized sufficiently to reinforce the section against localized distress during transportation and handling and against excess contact bearing pressures through the joint.
- H. Vault shall be solid walled construction:
1. Where penetrations of the pre-cast concrete vault are required for piping, conduit, or ducts, such penetrations shall be accommodated through pre-cast openings or core-drilled sections.
 2. Openings for penetrations shall be smooth and free of surface irregularities and without exposed steel reinforcing.
 3. Vaults need not be designed to resist thrust from piping passing through the vault.
 4. Coordinate pipe penetration locations with piping arrangement as indicated on the Drawings.
- I. Slope bottom of vault to Drainage Sump as indicated on the Drawings.
- J. Drainage Sump: Dimensions as indicated on the Drawings:
1. Drainage Sump shall consist of an open knockout in the bottom of the vault. Provide additional reinforcing as required to accommodate knockout.
 2. Provide FRP grating with rebate as indicated on the Drawings:
 - a. Grating shall be designed for 300 pounds per square foot load with L/200 maximum deflection.
 - b. Provide removable grating sections to facilitate grating removal without disconnecting Automatic Sump Drain Ejector Assembly indicated on the Drawings.
- K. Ladders:
1. General:
 - a. Type:
 - 1) Safety type conforming to local, State, and OSHA standards as minimum.
 - 2) Furnish guards for ladder wells.
 - b. Size: 18 inches wide between side rails of length, size, shape, detail, and location indicated on the Drawings.
 2. Aluminum ladders:
 - a. Materials: 6063-T5 aluminum alloy.
 - b. Rungs:
 - 1) 1-inch minimum solid square bar with 1/8-inch grooves in top and deeply serrated on all sides.
 - 2) Capable of withstanding 1,000 pound load without failure.
 - c. Side rails: Minimum 4-inch by 1/2-inch flat bars.
 - d. Fabrication:
 - 1) Welded construction, of size, shape, location, and details indicated on the Drawings.

2.02 ACCESS HATCH

- A. Where openings for access to the vault are required, the full clear space opening indicated shall be provided, without obstructions from brackets or supports. For

large openings where brackets or supports are designed to protrude into the opening for support of required covers, such brackets or supports shall be designed to be easily removed and replaced with a minimum of effort and without cutting or welding.

- B. Access hatch as specified in Section 08_31_14 - Floor Access Doors for access floor requirements.

2.03 COATINGS

- A. Coat interior and exterior of valve vault in accordance with Section 09_96_01 - High-Performance Coatings or as indicated on the Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Pre-cast concrete sections shall be transported and handled with care in accordance with the manufacturer's written recommendations:
 - 1. Where lifting devices are provided in pre-cast sections, such lifting devices shall be used as intended.
 - 2. Where no lifting devices are provided, the Contractor shall follow the manufacturer's recommendations for lifting procedures to provide proper support during lifting.
- B. Buried pre-cast concrete vaults shall be assembled and placed in excavations on properly compacted soil foundations as indicated. Pre-cast concrete vaults shall be set to grade and oriented to provide the required dimensions and clearances from pipes and other structures.
- C. Apply coatings in accordance with manufacturer's instructions.
- D. Ladders:
 - 1. Secure to supporting surface with bent plate clips providing minimum 8 inches between supporting surface and center of rungs.
 - 2. Anchorage by manufacturer.
 - 3. Where exit from ladder is forward over top rung, extend side rails 3 feet 3 inches minimum above landing, and return the rails with a radius bend to the landing.
 - 4. Where exit from ladder is to side, extend ladder 5 feet 6 inches minimum above landing and rigidly secure at top.
 - 5. Erect rail straight, level, plumb, and true to position indicated on the Drawings. Correct deviations from true line or grade which are visible to the eye.

END OF SECTION

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SECTION 33_05_19

DUCTILE IRON PIPE: AWWA C151 – INFRASTRUCTURE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Ductile iron pipe, joints, connections, fittings, and pipe linings and coatings.
- B. As specified in Section 33_05_00.01 - Common Work Results for General Piping - Infrastructure.

1.02 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. C104 - Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 - 2. C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - 3. C110 - Standard for Ductile-Iron and Gray-Iron Fittings.
 - 4. C111 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 5. C115 - Standard for Flanged Ductile-Iron Pipe with Threaded Flanges.
 - 6. C150 - Standard for Thickness Design of Ductile-Iron Pipe.
 - 7. C151 - Standard for Ductile-Iron Pipe, Centrifugally Cast.
 - 8. C153 - Standard for Ductile-Iron Compact Fittings for Water Service.
 - 9. C600 - Installation of Ductile Iron Water Mains and Their Appurtenances.
- B. ASTM International (ASTM):
 - 1. A536 - Standard Specifications for Ductile Iron Castings.
- C. Ductile Iron Pipe Research Association (DIPRA):
 - 1. Thrust Restraint Design Manual.

1.03 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data.
- C. Shop drawings:
 - 1. Detailed layout drawings showing alignment of pipes, location of valves, fittings, and appurtenances, types of joints, and connections to pipelines or structures.
 - 2. Thrust restraint systems.
 - 3. Photographs, drawings, and descriptions of fittings, gaskets, couplings, grooving of pipe and fittings.
- D. Calculations:
 - 1. Calculations for thrust restraint system design.

- E. Manufacturer's source testing.

1.04 QUALITY ASSURANCE

- A. Ductile iron pipe shall be supplied by a single manufacturer.
- B. Hydrostatically test each joint of ductile iron pipe in accordance with AWWA C151.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Block piping and associated fittings for shipment to prevent damage to coatings and linings.
- B. Carefully handle piping and associated fittings during loading, unloading, and installation:
 - 1. Do not drop piping material from cars or trucks.
 - 2. Lower piping by mechanical means.
 - 3. Do not drop or pound pipe to fit grade.
- C. Protect gaskets and polyethylene encasement from long-term exposure to sunlight.
- D. Store piping, fittings, and other accessories such that they do not accumulate and hold rainwater, dirt, and debris.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Ductile iron piping:
 - 1. Manufacturers:
 - a. American Cast Iron Pipe Co.
 - b. Pacific States Cast Iron Pipe Co.
 - c. SIP Industries.
 - d. U.S. Pipe.

2.02 THRUST RESTRAINT SYSTEM DESIGN

- A. The length of pipe that must be restrained on each side of the focus of a thrust load as indicated on the Drawings.
- B. Design pressure: As indicated on the Drawings.
- C. Laying condition: Type 3 in accordance with AWWA C150.
- D. Soil type: Silt 1.
- E. Unit friction resistance for polyethylene encasement of pipe: DIPRA factor multiplied by a safety factor of 1.5.

2.03 CONCRETE THRUST BLOCK RESTRAINT

- A. Joint thrust restraint system designed by Contractor:
 - 1. Concrete thrust blocks will only be permitted in certain locations where indicated on the Drawings.

2.04 DUCTILE IRON JOINTS AND CONNECTIONS

- A. General:
 - 1. Ductile iron pipe shall be the following Special Thickness Class, minimum:
 - a. Bolted flange joints: Special Thickness Class 53.
 - b. Restrain mechanical joints: Special Thickness Class 50.
 - c. All other ductile iron pipe: Special Thickness Class 52.
 - 2. In accordance with AWWA C150 and AWWA C151.
 - 3. Joints:
 - a. Flanged.
 - b. Mechanical.
 - c. Mechanical Wedge Action.
 - d. Push-On Joint Restraint Harness.
 - 4. Connections:
 - a. Tapping saddle.
 - b. Tapping sleeve.
 - c. Welded outlet.
 - 5. Fittings.
- B. Joints:
 - 1. Flanged joints:
 - a. Screw-on flanges: Comply with the diameter, thickness, drilling, and other characteristics in accordance with ANSI A21.10/AWWA C110 or ANSI A21.15/AWWA C115. In addition, comply with the following requirements:
 - 1) Ductile iron.
 - 2) Long hub, threaded, and specially designed for ductile iron pipe.
 - 3) After attaching to pipe, machine flange face to make pipe end and flange even and perpendicular to the axis of the pipe.
 - b. Bolt holes on flanges: 2-holed and aligned at both ends of pipe.
 - c. Cap screw or stud bolt holes: Tapped.
 - d. Bolts and nuts: As specified in Section 33_05_00.01 - Common Work Results for General Piping.
 - e. Gaskets: EPDM unless specified otherwise in Section 33_05_00.01 - Common Work Results for General Piping.
 - 2. Mechanical joints: In accordance with ANSI A21.11 or AWWA C111:
 - a. Gaskets: As specified in Section 33_05_00.01 - Common Work Results for General Piping.
 - b. Bolts and nuts, including T-bolts: As specified in Section 33_05_00.01 - Common Work Results for General Piping.
 - 3. Mechanical wedge action joint restraints:
 - a. Manufacturers: One of the following or equal:
 - 1) Romac Industries, Inc., ROMAGRIP.
 - 2) EBAA Iron, Inc., Megalug® Series 1100.
 - 3) Star Pipe Products, Split Stargrip Series 3000.
 - 4) Sigma Corp., One-Lok Model SLDE.

- b. Materials:
 - 1) Gland body: Ductile iron in accordance with ASTM A536.
 - 2) Wedges and wedge actuating components: Ductile iron in accordance with ASTM A536:
 - a) Wedges shall be heat treated to a minimum of 370 BHN.
 - 3) Actuating bolts and nuts: Ductile iron in accordance with ASTM A536:
 - a) Provide torque-limiting twist off components to ensure proper installation.
 - 4) Gaskets: As specified in Section 33_05_00.01 - Common Work Results for General Piping.
 - c. Coatings:
 - 1) Provide manufacturer applied coating system.
 - 2) Manufacturers: One of the following or equal:
 - a) Romac Industries, Inc., Romabond.
 - b) EBAA Iron Inc., Mega-Bond.
 - c) Star Pipe Products, Star-Bond.
 - d) Sigma Corp., Corrsafe™ Electro-deposition coating.
 - d. Working pressure:
 - 1) Shall include a minimum safety factor of 2:1.
 - 2) For sizes 3- through 16-inch: 350 pounds per square inch.
 - 3) For sizes 18- through 48-inch: 250 pounds per square inch.
 - e. Restraint shall consist of multiple gripping wedges incorporated into a follower gland meeting the requirements of AWWA C111.
 - f. Restraint shall allow post assembly angular deflection that is a minimum of 50 percent of the angular deflection allowed by the mechanical joint.
 - g. Restraint must be in accordance with applicable requirements of AWWA C110 and AWWA C111 for mechanical joints.
4. Push-on joint restraint harnesses:
- a. Manufacturers: One of the following or equal:
 - 1) EBAA Iron, Inc., Megalug® Series 1700.
 - 2) Star Pipe Products, Split Stargrip Series 3100S.
 - 3) Sigma Corp., One-Lok Model SLDEH.
 - b. Materials:
 - 1) Restraint and backup ring: Ductile iron in accordance with ASTM A536.
 - 2) Wedges and wedge actuating components: Ductile iron in accordance with ASTM A536:
 - a) Wedges shall be heat treated to a minimum of 370 BHN.
 - 3) Actuating bolts and nuts: Ductile iron in accordance with ASTM A536:
 - a) Provide torque-limiting twist off components to ensure proper installation.
 - 4) Tie rods: Low alloy steel in accordance with AWWA C111.
 - 5) Bolts and nuts, including T-bolts: As specified in Section 33_05_00.01 - Common Work Results for General Piping.
 - c. Coatings:
 - 1) Provide manufacturer applied coating system.
 - 2) Manufacturers: One of the following or equal:
 - a) EBAA Iron Inc., Mega-Bond.
 - b) Star Pipe Products, Star-Bond.
 - c) Sigma Corp., Corrsafe™ Electro-deposition coating.

- d. Working pressure:
 - 1) Shall include a minimum safety factor of 2:1.
 - 2) For sizes 3- through 16-inch: 350 pounds per square inch.
 - 3) For sizes 18- through 48-inch: 250 pounds per square inch.
- e. Restraint shall consist of a backup ring behind the ductile iron bell and a restraint ring consisting of multiple gripping wedges connected with number and type of tie rods as recommended by the manufacturer.
- f. Restraint shall allow post assembly deflection of a minimum of 50 percent of the deflection capability of the push-on joint.

C. Connections:

- 1. Tapping saddle as specified in Owner standard specification:
 - a. If Owner does not have a standard specification, provide tapping saddles as specified in Section 40_05_06.01 - Piping Specialties.
- 2. Tapping sleeve as specified in Owner standard specification:
 - a. If Owner does not have a standard specification, provide tapping sleeves as specified in Section 40_05_06.01 - Piping Specialties.
- 3. Welded outlet:
 - a. Not allowed without Engineer approval.

D. Fittings:

- 1. Ductile iron in accordance with AWWA C110 or AWWA C153.
- 2. Joint type: Same as that of the associated piping as specified in Section 33_05_00.01 - Common Work Results for General Piping.
- 3. Plain end-to-flanged joint connectors using setscrews are not acceptable.

E. Pipe and fitting linings:

- 1. Cement-mortar lining:
 - a. In accordance with AWWA C104, apply cement-mortar on clean bare metal surfaces. Extend to faces of flanges, ends of spigots, and shoulders of hubs.
 - b. Minimum lining thickness: Double thickness in accordance with AWWA C104.
- 2. Asphaltic seal coat:
 - a. Pipe and fittings shall be seal coated with bituminous material in accordance with ANSI A21.4/AWWA C104 and shall have exterior bituminous coating conforming to ANSI A21.4/AWWA C104.

F. Discard piping or reline piping when pinholes or discontinuities are found. Coatings:

- 1. Asphalt varnish: Factory applied.
- 2. Primer:
 - a. Factory applied for field coating.
 - b. Compatible with materials as specified in Section 09_96_01 - High-Performance Coatings.

2.05 POLYETHYLENE ENCASEMENT

A. General:

- 1. Polyethylene encasement shall be supplied by the pipe manufacturer.

B. Materials: Supply one of the following polyethylene encasements:

- 1. 2 layers of linear low-density polyethylene (LLDPE) film, minimum thickness of 8 mils in accordance with AWWA C105; or,

2. Single layer of high-density, cross-laminated polyethylene (HDCLPE) film, minimum thickness of 4 mils in accordance with AWWA C105.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Install ductile iron piping in accordance with AWWA C600, or as modified in Section 33_05_00.01 - Common Work Results for General Piping.
2. For underground piping, the trenching, backfill, and compaction: As specified in Section 31_23_35 - Trenching.
3. Water main connections shall use Romac couplings or approved equal when joining new ductile iron water main to existing PVC or asbestos cement water main.

B. Polyethylene encasement:

1. Wrap all buried ductile iron pipe and fittings in 2 layers of loose low-density polyethylene wrap or a single layer of high-density polyethylene wrap in accordance with AWWA C105.
2. Polyethylene encasement shall be continuous and terminated neatly at connections to below grade equipment or structures.
3. At wall penetrations, extend encasement to the wall and neatly terminate.
4. At slab penetrations, extend encasement to 2 inches below the top of slab and neatly terminate.
5. When rising vertically in unimproved areas, extend encasement 6 inches above existing grade and neatly terminate.
6. Repair tears and make joints with 2 layers of plastic tape.
7. All work shall be inspected prior to backfilling of pipe and associated items.

C. Joints:

1. Install types of joints as specified in the piping schedule provided in Section 33_05_00.01 - Common Work Results for General Piping.
2. Mechanical joints are not acceptable in above ground applications.
3. Field closure for restrained push-on pipe:
 - a. Locate field closures in areas where thrust calculations demonstrate restraint is not required.

D. Connection:

1. Tapping ductile iron pipe:
 - a. The maximum allowable tap diameter for pipelines greater than 24 inches is 2 inches.
 - b. 2 layers of 3-mil thread sealant are required to minimize the torque required to effect a watertight connection.
2. When direct tapping of ductile iron pipe is not possible due to limited wall thickness, a saddle tap shall be used.

3.02 FIELD QUALITY CONTROL

A. Testing ductile iron piping:

1. Test as specified in Section 33_05_00.01 - Common Work Results for General Piping and Section 40_05_00.09 - Piping Systems Testing.

- B. Repair damaged cement mortar lining to match quality, thickness, and bonding of original lining in accordance with AWWA C104:
 - 1. When lining cannot be repaired or repairs are defective, replace defective piping with undamaged piping.

END OF SECTION

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SECTION 40_05_00.03

PIPE IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Pipe identification including the following:
 - 1. Pipe identification by color and legend.
 - 2. Underground warning tape.
 - 3. Tracer wire.
 - 4. Witness markers.
 - 5. Valve identification.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. A13.1 - Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Submit following:
 - 1. Product data.
 - 2. Samples.
 - 3. Manufacturer's installation instructions.
 - 4. Submit following as specified in Section 01_77_00 - Closeout Procedures:
 - a. Operation and Maintenance Data.
 - b. Warranty.

PART 2 PRODUCTS

2.01 ABOVE GROUND AND IN-CHASE PIPE IDENTIFICATION

- A. Manufacturers:
 - 1. One of the following or equal:
 - a. Seton, Opti Code Pipe Markers.
 - b. Lab Safety Supply.
 - c. Marking Services, Inc.

B. Materials:

1. Pipe markers: Self-adhesive vinyl, suitable for outdoor application from -40 degrees to 180 degrees Fahrenheit; in accordance with ASME A13.1 requirements:
 - a. Lettering:

Nominal Pipe Diameter	Lettering Size
Less than 1.5 inches	1/2-inch
1.5 inches to 2 inches	3/4-inch
2.5 inches to 6 inches	1-1/4 inches
8 inches to 10 inches	2-1/2 inches
Over 10 inches	3-1/2 inches

- b. Marker colors:

Service	Lettering	Background
Flammables, chemicals, toxics	Black	Yellow
Water, nontoxic solutions or low hazard liquids	White	Green
Nonflammable or nontoxic gases	White	Blue
Fire quenching fluids (foam, fire water, CO ₂ Halon)	White	Red

2. Coating: As specified in Section 09_96_01 - High-Performance Coatings.
3. Pipe identification tags: Aluminum or stainless steel with stamped-in 1/4-inch high identifying lettering.
4. Pipe identification tag chains: Aluminum or stainless steel.
5. Snap-on markers: Markers with 3/4-inch high letters for 3/4 to 4-inch pipe or covering, or 5-inch high letters for 5-inch or larger pipe or cover:
 - a. Manufacturers: One of following or equal:
 - 1) Brady BradySnap-On B-915.
 - 2) Seton Setmark.

2.02 BURIED PIPELINE IDENTIFICATION

A. Underground warning tape:

1. Manufacturer: One of the following or equal:
 - a. Seton Name Plate Co.
 - b. T. Christy Enterprises, Inc.
2. Material:
 - a. Polyethylene tape for prolonged underground use.
 - b. Minimum tape thickness: 4 mils.
 - c. Overall tape width: 6 inches.
 - d. Message: "CAUTION" with the name of the service followed by "LINE BURIED BELOW." in black lettering on colored background in accordance with approved APWA colors:
 - 1) Water: Blue.

- 2) Sewer: Green.
- 3) Telephone: Orange.
- 4) Gas and other services: Yellow.

B. Tracer wire:

1. Manufacturers: One of the following or equal:
 - a. Kris-Tech Wire.
 - b. Corpro.
2. Materials: One of the following or equal:
 - a. Solid copper conductor.
 - b. Thickness minimum: 10 gauge.
 - c. Insulation:
 - 1) Match insulation color to the color of the pipe being installed.
 - 2) UF type, direct bury.
 - 3) 30 mil HMWPE.
3. Splicing Kit:
 - a. Manufacturers: One of the following or equal:
 - 1) Ryall Electric Co., 3M Kit#82-A1.
4. Station Box:
 - a. Lid and collar materials: Cast iron.
 - b. Able to withstand heavy traffic loading.
 - c. Manufacturers: One of the following or equal:
 - 1) Farwest Corrosion Control Co, Glenn 4 Test Station.

2.03 VALVE AND GATE IDENTIFICATION

A. Provide valve and gate schedule for each valve and gate in the Work with the following information:

1. Identification number.
2. Location.
3. Type.
4. Function.
5. Normal operating position.

B. Identification tag requirements.

1. Diameter: 2-inches.
2. Material:
 - a. Buried applications: Stainless steel or brass.
 - b. Buried applications with concrete marker: Brass.
 - c. Above ground and in-chase applications: 19 gauge aluminum or PVC.
3. Stamp tags in 1/4-inch high letters.
4. Provide non-corrosive metal wire suitable for attaching the tag to the operator base.
5. Secure tags to valve or gate:
 - a. Attach tags in such a way as to allow free and full operation of the valve or gate.
6. Buried applications with concrete marker: Secure tags to concrete marker.

C. Submittal requirements:

1. Submit 2 samples of the type of tag proposed and the manufacturer's standard color chart and letter styles to the Engineer for review.

- D. Manufacturer: The following or equal:
1. Seton Name Plate Co.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify satisfactory conditions of substrate for applying identification.
- B. Verify that conditions are satisfactory for installation and application of products as specified in Section 01_60_00 - Product Requirements.

3.02 PREPARATION

- A. Prepare and coat surfaces as specified in Section 09_96_01 - High-Performance Coatings.
- B. Prepare surface in accordance with product manufacturer's instructions.

3.03 ABOVE GROUND AND IN-CHASE PIPING IDENTIFICATION

- A. Identify exposed piping, valves, and accessories in accessible chases with lettering or tags designating service of each piping system with flow directional arrows and color code.
- B. Color code:
 1. Paint piping with colors as scheduled in Piping Color Code and Marker Schedule.
- C. Lettering and flow direction arrows:
 1. Stencil lettering on painted bands or use snap-on markers on pipe to identify pipe. When stenciling, stencil 3/4-inch high letters on 3/4 through 4-inch pipe or coverings, or 5-inch high letters on 5-inch and larger pipe or coverings.
 2. Provide lettering and flow direction arrows near equipment served, adjacent to valves, both sides of walls and floors where pipe passes through, at each branch or tee, and at intervals of not more than 50 feet in straight runs of pipe.
- D. Metal tags:
 1. Where outside diameter of pipe or pipe covering is 5/8-inch or smaller, provide metal pipe identification tags instead of lettering.
 2. Fasten pipe identification tags to pipe with chain.
 3. Where tags are used, color code pipe as scheduled.

3.04 BURIED PIPING IDENTIFICATION

- A. Underground warning tape:
 1. Place continuous run of warning tape in pipe trench, 12 inches above the pipe.
- B. Tracer wire:
 1. Install on all non-metallic pipe.
 2. Install an electrically continuous run of tracer wire along the entire length of the pipe with wire terminations in valve boxes, vaults, or structures.

3. Install tracer wire on top of the pipe and secure to pipe with tape a minimum of every 10 feet.
4. Where approved by the Engineer, splice sections of wire together using approved direct bury wire nuts:
 - a. Twisting the wires together is not acceptable.

3.05 APPLICATION

- A. Identify piping with legend markers, directional arrow markers, and number markers; use self-adhesive arrow roll tape to secure ends of piping markers and indicate flow direction.
- B. Provide legend markers, directional arrow markers, and number markers where piping passes through walls or floors, at piping intersections and at maximum 15-foot spacing on piping runs.
- C. Provide piping marker letters and colors as scheduled.
- D. Place markers on piping so they are visible from operator's position in walkway or working platform near piping. Locate markers along horizontal centerline of pipe, unless better visibility is achieved elsewhere.

3.06 PIPING COLOR CODE AND MARKER SCHEDULE

Service Fluid	Pipe Color	Marker Legend
Brine Solution	Dark Blue	BRINE SOLUTION
Chemical Drain	Charcoal	CHEMICAL DRAIN
Domestic Cold Water	Light Blue	DOMESTIC COLD WATER
Domestic Hot Water	Light Blue	DOMESTIC HOT WATER
Drain	Charcoal	DRAIN
Return Water	Silver/Grey	RETURN WATER
Sample	Green	FLUID BEING SAMPLED
Sanitary Drain	Charcoal	SANITARY DRAIN
Sodium Hypochlorite	Yellow	CHLORINE SOLUTION
Vent Pipe	Yellow	VENT PIPE

Letters	Color of Pipe	Color of Bands	Color of Letters
Finished or Potable (cold)	Light blue	None	Black
Potable (hot)	Light blue	Red	Black
Service Water (lines downstream from backflow prevention unit)	Dark Blue	White	Red

Letters	Color of Pipe	Color of Bands	Color of Letters
Sample	Dark Blue	Black	White
Fire Protection	Red	None	Black
Hydrants	Aluminum	None	Black
Drain	Dark Gray	None	White

END OF SECTION

SECTION 40_05_00.09
PIPING SYSTEMS TESTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Test requirements for piping systems.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
1. B31.1 - Power Piping.
 2. B31.3 - Process Piping.
 3. B31.8 - Gas Transmission and Distribution Piping Systems.
- B. Underwriters Laboratories Inc. (UL).

1.03 TESTING REQUIREMENTS

- A. General requirements:
1. Testing requirements are stipulated in Laws and Regulations; are included in the Piping Schedule in Section 33_05_00.01 - Common Work Results for General Piping; are specified in the specifications covering the various types of piping; and are specified in this Section.
 2. Requirements in Laws and Regulations supersede other requirements of Contract Documents, except where requirements of Contract Documents are more stringent, including higher test pressures, longer test times, and lower leakage allowances.
 3. Test plumbing piping in accordance with Laws and Regulations, the plumbing code, as specified in Section 01_41_00 - Regulatory Requirements, and UL requirements.
- B. Furnish necessary personnel, materials, and equipment, including bulkheads, restraints, anchors, temporary connections, pumps, water, pressure gauges, and other means and facilities required to perform tests.
- C. Water for testing, cleaning, and disinfecting:
1. Water for testing, cleaning, and disinfecting will be provided as specified in Section 01_50_00 - Temporary Facilities and Controls.
- D. Pipes to be tested: Test only those portions of pipes that have been installed as part of this Contract. Test new pipe sections prior to making final connections to existing piping. Furnish and install test plugs, bulkheads, and restraints required to isolate new pipe sections. Do not use existing valves as test plug or bulkhead.
- E. Unsuccessful tests:
1. Where tests are not successful, correct defects or remove defective piping and appurtenances and install piping and appurtenances that comply with the specified requirements.

2. Repeat testing until tests are successful.
- F. Test completion: Drain and leave piping clean after successful testing.
- G. Test water disposal: Dispose of testing water at the sanitary sewer or as directed by the Owner in accordance with requirements of federal, state, county, and city regulations governing disposal of wastes in the location of the Project and disposal site.

1.04 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Schedule and notification of tests:
1. Submit a list of scheduled piping tests by noon of the working day preceding the date of the scheduled tests.
 2. Notification of readiness to test: Immediately before testing, notify Engineer in writing of readiness, not just intention, to test piping.
 3. Have personnel, materials, and equipment specified in place before submitting notification of readiness.

1.05 SEQUENCE

- A. Clean piping before pressure or leak tests.
- B. Underground pressure piping may be tested before or after backfilling when not indicated or specified otherwise:
1. Joints shall remain exposed until a successful test is completed.
- C. Backfill and compact trench or provide blocking that prevents pipe movement before testing underground piping.
- D. Test underground piping before encasing piping in concrete or covering piping with slab, structure, or permanent improvement.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 TESTING ALIGNMENT, GRADE, AND DEFLECTION

- A. Alignment and grade:
1. Visually inspect the interior of gravity piping with artificial light, reflected light, or laser beam.
 2. Consider inspection complete when no broken or collapsed piping, no open or poorly made joints, no grade changes that affect the piping capacity, or no other defects are observed.

3.02 TESTING GRAVITY FLOW PIPING

- A. Test gravity flow piping indicated with "GR" in the Piping Schedule, as follows:
 - 1. Unless specified otherwise, subject gravity flow piping to the following tests:
 - a. Alignment and grade.
 - b. For plastic piping test for deflection.
 - c. Visible leaks and pressure with maximum leakage allowance, except for storm drains and culverts.
 - 2. Inspect piping for visible leaks before backfilling.
 - 3. Provide temporary restraints when needed to prevent movement of piping.
 - 4. Pressure test piping with maximum leakage allowance after backfilling.
 - 5. With the lower end plugged, fill piping slowly with water while allowing air to escape from high points. Keep piping full under a slight head for the water at least 24 hours:
 - a. Examine piping for visible leaks. Consider examination complete when no visible leaks are observed.
 - b. Maintain piping with water or allow a new water absorption period of 24 hours for the performance of the pressure test with maximum leakage allowance.
 - c. After successful completion of the test for visible leaks and after the piping has been restrained and backfilled, subject piping to the test pressure for minimum of 4 hours while accurately measuring the volume of water added to maintain the test pressure:
 - 1) Consider the test complete when leakage is equal to or less than the following maximum leakage allowances:
 - a) For other piping: 80 gallons per day per inch diameter per mile of piping under test.

3.03 TESTING HIGH-HEAD PRESSURE PIPING

- A. Test piping for which the specified test pressure in the Piping Schedule is 20 pounds per square inch gauge or greater, by the high head pressure test method, indicated "HH" in the Piping Schedule.
- B. General:
 - 1. Test connections, hydrants, valves, blowoffs, and closure pieces with the piping.
 - 2. Do not use installed valves for shutoff when the specified test pressure exceeds the valve's maximum allowable seat differential pressure. Provide blinds or other means to isolate test sections.
 - 3. Do not include valves, equipment, or piping specialties in test sections if test pressure exceeds the valve, equipment, or piping specialty safe test pressure allowed by the item's manufacturer.
 - 4. During the performance of the tests, test pressure shall not vary more than plus or minus 5 pounds per square inch gauge with respect to the specified test pressure.
 - 5. Select the limits of testing to sections of piping. Select sections that have the same piping material and test pressure.
 - 6. When test results indicate failure of selected sections, limit tests to piping:
 - a. Between valves.
 - b. Between a valve and the end of the piping.
 - c. Less than 500 feet long.

7. Test piping for minimum 2 hours for visible leaks test and minimum 2 hours for the pressure test.
- C. Testing procedures:
1. Fill piping section under test slowly with water while venting air:
 - a. Use potable water for all potable waterlines and where noted on the Piping Schedule.
 2. Before pressurizing for the tests, retain water in piping under slight pressure for a water absorption period of minimum 24 hours.
 3. Raise pressure to the specified test pressure and inspect piping visually for leaks:
 - a. Consider visible leakage testing complete when no visible leaks are observed.
 4. Begin pressure test after completion of visible leaks test:
 - a. If there are no visible leaks and zero water loss indicated by zero loss in pressure for 2 hours the main will be accepted as a watertight installation.

END OF SECTION

SECTION 40_05_06.01

PIPING SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Piping specialties including:
 - 1. Pipe saddles.
 - 2. Tapping sleeves.
 - 3. Chemical Injectors.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24.
- B. American Water Works Association (AWWA):
 - 1. C110 - Standard for Ductile-Iron and Gray-Iron Fittings.
 - 2. C151 - Standard for Ductile-Iron Pipe, Centrifugally Cast.
- C. ASTM International (ASTM):
 - 1. A148 - Standard Specification for Steel Castings, High-Strength, for Structural Purposes.
 - 2. A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - 3. A194 - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - 4. A536 - Standard Specification for Ductile Iron Castings.
- D. NSF International (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects, Includes Errata.
 - 2. 372 - Drinking Water System Components - Lead Content.

1.03 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
 - 1. For each piping product in this Section as applicable:
 - a. Design features.
 - b. Load capacities.
 - c. Material designations by UNS alloy number or ASTM Specification and Grade.
 - d. Data needed to verify compliance with the Specifications.
 - e. Catalog data.
 - f. Clearly mark submittal information to show specific items, materials, and accessories or options being furnished.

- C. Calculations:
 - 1. Provide calculations in accordance with NSF 372 for materials in contact with drinking water.
- D. Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01_75_17 - Commissioning:
 - 1. Provide as specified in this Section.

1.04 WARRANTY

- A. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

- A. As specified in Section 01_60_00 - Product Requirements.
- B. Materials in contact with drinking waters: In accordance with NSF 61 and NSF 372.

2.02 PIPE SADDLES

- A. Manufacturers: One of the following or equal:
 - 1. Romac Industries, Inc., Style 202NS.
- B. Materials:
 - 1. Pipe saddles: Ductile iron.
 - 2. Straps, bolts, and nuts: Type 304 stainless steel with Teflon™ coating on nuts.
 - 3. Gaskets: EPDM.

2.03 TAPPING SLEEVES

- A. Manufacturers: One of the following or equal:
 - 1. Smith-Blair, Inc., Style 622.
 - 2. Romac Industries, Inc., Style FTS 420.
- B. Materials:
 - 1. Tapping sleeves: Steel construction.
 - 2. Bolts and nuts: Type 304 stainless steel.
 - 3. Nuts: Teflon™ coated.
 - 4. Gaskets: EPDM.
 - 5. Size of tapped boss: As indicated on the Drawings.

2.04 CHEMICAL INJECTORS

- A. Design:
 - 1. Chemical Injector:
 - a. Injector configuration: Single feed point into center of water main.
 - b. Operating pressure 100 psi.
 - 2. Heavy duty stainless steel ball valve:
 - a. Flanged connection.

3. Injector solution tube sized to match pump discharge line:
 - a. Tube shall extend 1/3 to 1/2 diameter of water main into center of main.
 - b. Able to safely withdraw or insert injector/diffuser tube into center of water main while under pressure and without having to shut down the main.
 - c. Ball check valve located on injector solution tube.
 - d. Stainless steel safety chain located on injector/diffuser solution tube.

B. Materials:

1. Injector: Compatible with sodium hypochlorite solution.

C. Manufacturers: The following or equal:

1. Saf-T-Flo, FL-100.

2.05 SHIPPING

- A. As specified in Section 01_60_00 - Product Requirements.

PART 3 EXECUTION

3.01 GENERAL

- A. As specified in Section 01_60_00 - Product Requirements.
- B. Drawings supersede conflicts with this Section.
- C. Bellows type expansion joints and vibration control joints:
 1. Protect joints against damage during pressure test.

3.02 INSTALLATION

- A. Pipe saddles:
 1. Coat threads on bolts with anti-gall coating prior to installation.
- B. Tapping sleeves:
 1. Verify existing pipe material and outer diameter prior to ordering materials.
 2. Large diameter pipe:
 - a. Verify the existence of lining material.
 - b. Verify lining material type.
 - c. Repair lining after hot tap operations are complete with similar lining or equal.
 - d. Demonstrate ability to accomplish hot tap by staging a dry run simulation of the procedure prior to the initiation of the hot tap procedure:
 - 1) Walk through each step of the hot tap installation, and show the Engineer every component needed to install the hot tap, including but not limited to, tools and materials, to ensure that all the required components are on-site and in place prior to beginning the procedure.
 3. Coat threads on bolts with anti-gall coating prior to installation.

3.03 COMMISSIONING

- A. As specified in Section 01_75_17 - Commissioning and this Section.

- B. Manufacturer services:
 - 1. Required only for:
 - a. Tapping sleeves for large diameter pipe.
 - 2. Provide Manufacturer's Certificate of Installation and Functionality Compliance.
 - 3. Provide Manufacturer's Representative Onsite:
 - a. Installation: 1 trip/1 day each:
 - 1) Installation consultation and advice.
 - 2) Installation inspection.
- C. Field testing:
 - 1. As specified in Section 33_05_00.01 - Common Work Results for General Piping.

END OF SECTION

SECTION 40_05_06.03

PIPE COUPLINGS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Pipe couplings for ductile iron piping.
 - 2. Pipe couplings for carbon steel piping.
 - 3. Pipe couplings for stainless steel piping.

1.02 REFERENCES

- A. American National Standards Institute (ANSI).
- B. American Society of Mechanical Engineers (ASME):
 - 1. B31.1 - Power Piping.
 - 2. B31.9 - Building Services Piping.
- C. American Water Works Association (AWWA):
 - 1. C111 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 2. C207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In.
 - 3. C606 - Standard for Grooved and Shouldered Joints.
- D. ASTM International (ASTM):
 - 1. A36 - Standard Specification for Carbon Structural Steel.
 - 2. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 3. A193 - Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - 4. A351 - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
 - 5. A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/9 ksi Minimum Tensile Strength, General Use.
 - 6. A536 - Standard Specification for Ductile Iron Castings.
 - 7. A576 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
 - 8. D2000 - Standard Classification System for Rubber Products in Automotive Applications.
 - 9. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

- E. NSF International (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects.
 - 2. 372 - Drinking Water System Components - Lead Content.

1.03 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
 - 1. For each product in this Section as applicable:
 - a. Design features.
 - b. Load capacities.
 - c. Material designations by UNS alloy number or ASTM Specification and Grade.
 - d. Data needed to verify compliance with the Specifications.
 - e. Catalog data.
 - f. Clearly mark submittal information to show specific items, materials, and accessories or options being furnished.
- C. Calculations:
 - 1. Provide calculations in accordance with NSF 372 for materials in contact with drinking water.

1.04 WARRANTY

- A. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

- A. As specified in Section 01_60_00 - Product Requirements:
 - 1. Materials in contact with drinking waters: In accordance with NSF 61 and NSF 372.
- B. Known acceptable manufacturers are listed by specific products.
- C. Provide references as specified in this Section by specific product.
- D. Manufacturer's representatives' requirements as specified in Section 01_75_17 - Commissioning and this Section by specific product.
- E. Gaskets for flexible couplings and flanged coupling adapters:
 - 1. Provide gasket materials for piping applications as follows:
 - a. All piping applications: EPDM.

- F. Exterior coatings for underground and submerged applications:
 - 1. Manufacturers: One of the following or equal:
 - a. Tapecoat Co., Inc., T.C. Mastic.
 - b. Kop-Coat Co., Inc., Bitumastic Number 50.
 - 2. Thickness: Minimum 0.040 inch.

2.02 PIPE COUPLINGS FOR DUCTILE IRON PIPING

- A. Dismantling joints:
 - 1. Manufacturers: One of the following or equal:
 - a. Romac Ind., Inc., Style DJ400.
 - b. Smith-Blair, Inc., Series 975.
 - 2. Materials:
 - a. Flanged spool: AWWA C207 steel pipe:
 - 1) ASTM A53 for sizes 3 inches to 12 inches.
 - 2) ASTM A36 for sizes 14 inches to 72 inches.
 - b. End ring and body:
 - 1) For sizes 3 inches to 12 inches, ductile iron in accordance with ASTM A536.
 - 2) For sizes 14 inches to 72 inches, steel in accordance with ASTM A36 or A53.
 - c. Follower ring: Ductile iron in accordance with ASTM A536.
 - d. Bolts and hex nuts:
 - 1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
 - 2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F593.
 - e. Tie rods: High tensile steel in accordance with ASTM A193 Grade B7.
 - 3. Flange design: Class D steel ring flange in accordance with AWWA C207, compatible with ANSI Class 125 and 150 bolt circles.
 - 4. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.
- B. Flanged coupling adapters: Greater than 12-inch size:
 - 1. Manufacturers: One of the following or equal:
 - a. Romac Ind., Inc., Style FC400.
 - b. Dresser, Inc., Style 128-W.
 - c. Smith-Blair, Inc., Series 913.
 - 2. Materials:
 - a. Flange and flanged body: Ductile iron or low carbon steel having a minimum yield strength of 30,000 pounds per square inch.
 - b. Follower ring: Low carbon steel having a minimum yield strength of 30,000 pounds per square inch.
 - c. Bolts and hex nuts:
 - 1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
 - 2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F593.

3. Flange design: Class D steel ring flange in accordance with AWWA C207 compatible with ANSI Class 125 and 150 bolt circles.
 4. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.
- C. Flexible couplings:
1. Manufacturers: One of the following or equal:
 - a. Romac Ind., Inc., Style 501.
 - b. Dresser, Inc., Style 253.
 - c. Smith-Blair, Inc., Series 441.
 2. Materials:
 - a. Center rings: Ductile iron in accordance with ASTM A536.
 - b. Follower rings: Ductile iron in accordance with ASTM A536.
 - c. Bolts and hex nuts:
 - 1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
 - 2) Buried and underwater: Type 316 stainless steel in accordance with ASTM F593.
 3. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.
 4. Center sleeve dimensions: Provide center sleeves with lengths in accordance with following table:

Nominal Pipe Size	Sleeve Length
3 inch and smaller	Manufacturer's standard
4 inch through 8 inch	7 inches
10 inch through 14 inch	12 inches
Greater than 16 inch	Use steel flexible coupling per Pipe Couplings for Steel Piping

- D. Restrained flange coupling adapter:
1. Manufacturers: One of the following or equal:
 - a. Romac Ind., Inc., Style RFCA.
 - b. Star Pipe Products, 3200 StarFlange™.
 2. Materials:
 - a. Flange and flanged body: Ductile iron in accordance with ASTM A536.
 - b. Follower ring: Lug type restraint system:
 - 1) Follower ring: Ductile iron in accordance with ASTM A536.
 - 2) Restraining lugs: Ductile iron in accordance with ASTM A536.
 - a) Designed to contact the pipe and apply forces evenly.
 - 3) Restraining bolts:
 - a) Ductile iron in accordance with ASTM A536.
 - b) Bolt heads shall be designed to twist off when the proper torque has been applied.
 - c. Bolts and hex nuts:
 - 1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
 - 2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F593.

3. Flange design: Class D steel ring flange in accordance with AWWA C207 compatible with ANSI Class 125 and 150 bolt circles.
4. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.
5. Angular deflection: Restrained flange coupling adapter must allow angular deflection after assembly.

2.03 PIPE COUPLINGS FOR CARBON STEEL PIPING

- A. Flexible couplings:
 1. Manufacturers: One of the following or equal:
 - a. Romac Ind., Inc., Style 511 or Style 400.
 - b. Dresser, Inc., Style 38.
 - c. Smith-Blair, Inc., Series 411.
 2. Materials:
 - a. Center sleeve and follower flanges: Ductile iron or low carbon steel having a minimum yield strength of 30,000 pounds per square inch.
 - b. Bolts and hex nuts:
 - 1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
 - 2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F593.
 3. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.
 4. Center sleeve dimensions: Provide center sleeves with lengths in accordance with following table:

Nominal Pipe Diameter	Sleeve Length
2-1/2 inch and smaller	Manufacturer's standard
3 inch through 6 inch	7 inch
8 inch through 14 inch	7 inch
Greater than 14 inches	10 inch

PART 3 EXECUTION

3.01 INSTALLATION

- A. In underground and underwater installations, coat the exterior of coupling with a protective coating in accordance with manufacturer's instructions.
- B. Joints and flexible connections shall be installed centered with no angular deflection unless otherwise indicated on the Drawings.
- C. Flexible couplings and flange coupling adapters: Install with gap between pipe ends in accordance with the following table unless a greater gap is indicated on the Drawings. Maximum gap tolerance shall be within 1/8 inch:
 1. Install flexible coupling with pipe gap located in middle of center sleeve.

2. Install flanged coupling adapter with end of plain end pipe in middle of flanged coupling body.

Center Ring Length	Gap Dimension and Tolerance
4 inch through 6 inch	3/8 inch
7 inch	5/8 inch
10 inch and greater	7/8 inch

END OF SECTION

SECTION 40_05_06.10

STRAINERS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Strainers.

1.02 REFERENCES

- A. ASTM International (ASTM):
 1. A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 2. A420 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service.
- B. Society of Automotive Engineers (SAE).

1.03 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data: As specified in Section 33_05_00.01 - Common Work Results for General Piping.

PART 2 PRODUCTS

2.01 Y-TYPE STRAINERS

- A. Y-type strainers less than 4 inches in diameter:
 1. Materials:
 - a. Bodies: Cast iron or semi-steel.
 - b. Ends: Flanged or threaded.
 - c. Screen: Brass or Type 304 stainless steel.
 2. Suitable for maximum pressure of 250 pounds per square inch gauge.
 3. Screens: Perforations: 1/32 inch.
 4. Manufacturers: The following or equal:
 - a. Armstrong, Y-Type Strainer.

2.02 BASKET TYPE STRAINERS

- A. Provide basket type strainers as indicated on the Drawings.
- B. Materials:
 1. Bodies: PVC.
 2. Baskets: PVC.

- C. Pressure rating: Where not otherwise indicated on the Drawings, 125 pounds per square inch gauge, minimum.
- D. Connections: Socket with unions, as required.
- E. Covers:
 - 1. For strainers 6 inches and smaller in size, secured by yokes or similar quick opening devices.
- F. Baskets:
 - 1. Screen: Mesh or perforated sheet.
 - 2. Free area: Not less than 30 percent.
 - 3. Free area to pipe ratio: Not less than 3.
- G. Manufacturers: One of the following or equal:
 - 1. Hayward, SB Series.
 - 2. Dual or simplex as indicated on the Drawings; baskets and bodies PVC; EPDM gaskets; basket mesh size to be specified by the Engineer during shop drawing review.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with the manufacturer's recommendations.

3.02 COMMISSIONING

- A. As specified in Section 01_75_17 - Commissioning and this Section.

END OF SECTION

SECTION 40_05_06.23

FORCE BALANCED DUCTILE IRON BALL-TYPE FLEXIBLE EXPANSION JOINTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Force balanced ductile iron ball-type flexible expansion joints.

1.02 REFERENCES

- A. American Water Works Association (AWWA):
 1. C110 - Ductile-Iron and Gray-Iron Fittings.
 2. C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 3. C153 - Ductile-Iron Compact Fittings for Water Service.
 4. C210 - Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
 5. C213 - Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
- B. ASTM International (ASTM):
 1. A536 - Standard Specification for Ductile Iron Castings.
- C. NSF International:
 1. 14 - Plastics Plumbing System Components and Related Materials.
 2. 61 - Drinking Water System Components - Health Effects.

1.03 SYSTEM DESCRIPTION

- A. Design requirement:
 1. Performance requirements:
 - a. Joints capable of angular deflecting and expanding or contracting simultaneously without leakage.
 - b. Angular deflection: Capable of providing a minimum angular deflection from centerline at each ball joint as follows:
 - 1) 24-inch pipe: 15 degrees.
 - c. Axial movement capacity: Unless otherwise indicated on the Drawings, factory pre-set axial movement to reserve 50 percent of the total axial movement capacity for expansion and 50 percent of the total axial movement capacity for compression. Provide one or more expansion sleeves to provide a total axial movement:
 - 1) 24-inch: 12-inch minimum expansion or compression.
 - d. Working pressure rating:
 - 1) 24-inch: 250 pounds per square inch.

1.04 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.

- B. Product data: As specified in Section 33_05_00.01 - Common Work Results for General Piping.
- C. Source quality control test reports:
 - 1. Holiday test of lining.
 - 2. Pressure test.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. The following or equal:
 - 1. EBAA Iron, Inc., Force Balanced Flex-Tend.

2.02 MATERIALS

- A. Ductile iron: Material properties in accordance with ASTM A536 with wall thickness meeting requirements of AWWA C153.
- B. Gaskets:
 - 1. At ball joints and sleeves: EPDM.
 - 2. At flanged end connections: As specified in Section 33_05_00.01 - Common Work Results for General Piping.
 - 3. At mechanical joint end connections: As specified in Section 33_05_19 - Ductile Iron Pipe: AWWA C151.
- C. Bolts and nuts:
 - 1. At flanged end connections: As specified in Section 33_05_00.01 - Common Work Results for General Piping.

2.03 MANUFACTURED UNITS

- A. Consist of 2 ball and socket type joints with an expansion unit located between the 2 ball joints. The ball and socket ends shall be integrally cast with the expansion unit.
- B. End connections: Provide end connections indicated on the Drawings:
 - 1. Mechanical joint end connections in accordance with the dimensional requirements of either AWWA C111 or AWWA C153.
 - 2. Flange end connections in accordance with the dimensional requirements of AWWA C110 with the addition of an o-ring groove.
- C. NSF compliance requirements for installation of forced balanced ball-type flexible expansion joints in potable water systems: Lining, gasket material, lubricants, and other wetted components shall be certified to meet requirements of NSF Standard No. 61 and health effects portion of NSF Standard No. 14.

2.04 FINISHES

- A. Coat external surfaces as follows:
 - 1. Buried installations: Catalyzed coal tar epoxy in accordance with AWWA C210. Wrap fitting with polyethylene in same manner as for ductile iron pipe as specified in Section 33_05_19 - Ductile Iron Pipe: AWWA C151.
 - 2. Aboveground installations: Field apply coating system as specified in Section 33_05_00.01 - Common Work Results for General Piping for the piping system.

- B. Line all internal wetted surfaces and seal contact surfaces with a minimum of 15 mils of fusion-bonded epoxy in accordance with AWWA C213:
 - 1. Holiday test epoxy lining with a 1,500-volt spark test in accordance with AWWA C213.

2.05 SOURCE QUALITY CONTROL

- A. Pressure test to rated working water pressure before shipment.

2.06 PACKING AND SHIPPING

- A. Protect sliding and rotating surfaces against damage during packing and shipping and installation.

PART 3 EXECUTION

3.01 HANDLING

- A. Protect sliding and rotating surfaces against damage during handling and installation.

3.02 INSTALLATION

- A. Install force balance ductile iron ball-type flexible expansion joints in accordance with manufacturer's published instructions to meet minimum expansion and contraction values as specified or as indicated on the Drawings.

END OF SECTION

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SECTION 40_05_06.55

PIPING INSULATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Insulation for piping and related systems that are not plumbing systems.

1.02 REFERENCES

- A. ASTM International (ASTM):
 1. C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
 2. C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 3. C547 - Standard Specification for Mineral Fiber Pipe Insulation.
 4. C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
 5. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 6. E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.03 DEFINITIONS

- A. Buried: Piping that is installed below buildings, foundations, or finish grade, either in soil or encased in concrete in soil.
- B. Concealed: Piping above suspended ceilings and within walls, partitions, shafts, or service spaces and spaces not normally exposed to view but not buried.
- C. Exterior: Piping that is installed outside a building or within a pipe trench or tunnel.
- D. Flame spread and smoke density: Burning characteristics determined in accordance with ASTM E84.
- E. Interior: Piping that is installed inside a building.
- F. K factor: Thermal conductivity determined in accordance with ASTM C177 or C518.
- G. Mineral fiber: Fibers manufactured of glass, rock, or slag processed from a molten state, with or without a binder.
- H. Water vapor permeance: Water vapor transmission determined in accordance with ASTM E96 and expressed in units of perm-inch.

1.04 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data: As specified in Section 46_05_10 - Common Work Results for Mechanical Equipment:
 - 1. Insulation properties: Include K factor, thickness, density, operating temperature limits, tensile strength, compressive strength, moisture absorption, flame spread, and smoke developed in accordance with ASTM E84.
 - 2. Jacket properties: Include covering material, cover thickness, tensile strength, tear strength, permeability in accordance with ASTM E96, flame spread, and smoke developed in accordance with ASTM E84, closure type or devices, and accessories.
 - 3. Insulating blankets: Include materials, performance characteristics, method of attaching to equipment, listing of locations where insulating blankets will be installed.
 - 4. Manufacturer's application instructions: Include assembly and application drawings and detailed instructions.
 - 5. Laboratory report: Provide certified laboratory report stating that insulation is not manufactured using chlorinated polymers and does not contain chlorides, bromides, sulfates, or fire-rated materials.
- C. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 PIPE INSULATION, GENERAL REQUIREMENTS

- A. As specified in Section 01_60_00 - Product Requirements.
- B. Insulation thicknesses: Provide insulation thickness in inches in accordance with the following table. Insulation thickness shown is nominal. Manufacturing tolerance of 15 percent variation is permissible.

TABLE 1. Required Insulation Thicknesses

Required Insulation Thicknesses (inches)					
Service Temperature Range as Designated in Insulation Schedule at End of this Section	Nominal Pipe Diameters				
	1 inch and Less	1.25 to 2 inches	2.5 to 4 inches	5 to 10 inches	Over 10 inches
Exterior Chemical Pipes	1.0	1.0	1.0	1.5	2.0

2.02 PIPE INSULATION

- A. Insulation types: Provide in accordance with the insulation types listed and scheduled.
- B. Insulation, Type 1:
 - 1. Insulation material: Closed cell elastomeric insulation.

2. Minimum temperature range: Minus 40 degrees Fahrenheit to plus 220 degrees Fahrenheit.
3. K factor at 75 degrees Fahrenheit: Not more than 0.27 BTU-inch/hour-square feet-degrees Fahrenheit.
4. Fire ratings:
 - a. Flame spread: 25 or less.
 - b. Smoke density: 50 or less for insulation thicknesses up to 1.5 inches.
5. Joints: Seal with manufacturer's recommended contact adhesive to form continuous water barrier.
6. Manufacturers: One of the following or equal:
 - a. Armacell, AP Armaflex.
 - b. Aeroflex USA Inc., AeroceI® AC.

C. Insulation, Type 2:

1. Insulation material: Preformed mineral fiberglass insulation made from glass fibers bonded with a thermosetting resin:
 - a. In accordance with ASTM C547, Class 1.
 - b. Provide with factory installed vapor barrier:
 - 1) Material: White Kraft paper bound to aluminum foil in accordance with ASTM C1136, Type I.
 - 2) Longitudinal lap seals: Pressure-sensitive, self-sealing longitudinal lap strip with factory applied adhesive.
 - 3) Circumferential butt seals: 4-inch wide tape or similar properties or 4-inch wide overlap with adhesive seal.
 - 4) Vapor barrier permeability: 0.02 perms or lower.
 - 5) Vapor barrier flame spread rating: 25 or less.
2. Minimum temperature range: Minus 0 degrees Fahrenheit to plus 850 degrees Fahrenheit.
3. K factor at 75 degrees Fahrenheit: Not more than 0.23 BTU-inch/hour-square feet degrees Fahrenheit.
4. Maximum moisture absorption, volume percent: 5.
5. Manufacturers: One of the following or equal:
 - a. Owens-Corning , Fiberglas™ FLEXWRAP® ASJ.
 - b. Johns Manville, Micro-Lok® HP.
 - c. Knauf Insulation, Earthwool® Redi-Klad® 1000° Pipe Insulation.

2.03 INSULATION JACKETS

A. Jacket, Type 2:

1. Material: Ultraviolet-resistant polyvinyl chloride jacketing, 20 mil minimum thickness.
2. Fire rating: 25 maximum flame spread, smoke developed 50 or less.
3. Color: White.
4. Overlap: 1-inch minimum at joints and fittings.
5. Joint seal: PVC solvent welded or adhesive as recommended by the manufacturer.
6. Fittings: Factory made with full thickness insulation.
7. Manufacturers: One of the following or equal:
 - a. Johns Manville, Zeston® 2000 PVC.
 - b. Proto Corp., LoSMOKE PVC.
 - c. Speedline® Corp., Smoke-Safe™ PVC.

2.04 VAPOR BARRIERS

- A. Vapor barrier, Type 1:
 - 1. Material: White Kraft paper bound to aluminum foil in accordance with ASTM C1136, Type 1.
 - 2. Permeability: 0.02 perms or lower.
 - 3. Maximum flame spread rating: 25.
 - 4. Edge seal: Pressure-sensitive tape lap seal.
 - 5. Circumferential joints: 4-inch wide tape or 4-inch overlap with adhesive seal.

2.05 RELATED MATERIALS

- A. Cover adhesive: Premium adhesive as recommended by the insulation cover supplier for heavy-duty service in corrosive, wet environments. Standard-duty adhesives are not permitted.

2.06 REMOVABLE INSULATING BLANKETS

- A. In piping systems specified to be insulated, use removable insulating blankets for valves, strainers, and other in-line piping appurtenances and equipment requiring periodic servicing, regardless of pipe size.
- B. Size limits: Use removable insulating blankets for equipment and piping appurtenances 3 inches in nominal size and larger. For equipment and piping appurtenances less than 3 inches that do not require periodic servicing, insulate with molded sections of insulation or by field cutting insulation to conform to the shape of the component and to fit tightly around the component.
- C. Manufacturers: One of the following, or equal:
 - 1. Thermal Energy Products, Inc., Energy Wrap.
 - 2. Accessible Products, Thermazip 2000 Jacket.
 - 3. Owens Corning, Temp-Mat.
- D. Low temperature insulating blankets rated up to 800 degrees Fahrenheit:
 - 1. Use: For service temperatures up to 800 degrees Fahrenheit.
 - 2. Insulation: Fiberglass fiber, K factor 0.27 at 75 degrees Fahrenheit.
 - 3. Cover: 17-ounce fabric with both sides covered with silicone-impregnated glass cloth suitable for temperatures up to 800 degrees Fahrenheit.
 - 4. Cover fasteners: Use one of the following systems:
 - a. Grommets in the blanket and stainless steel wire.
 - b. 1-inch wide straps with stainless steel rectangular ring buckles and Velcro on strap tail.

2.07 SHIPPING

- A. As specified in Section 01_60_00 - Product Requirements.

PART 3 EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 01_60_00 - Product Requirements.

- B. Store insulation materials and accessories under cover and protected from moisture.

3.02 PREPARATION

- A. Pressure test piping and complete application of coating system before applying insulation.
- B. Before beginning installation of piping insulation, verify that the Engineer has accepted piping tests and pipe coating applications.

3.03 INSULATION SCHEDULE

- A. Table 2 - Insulation Schedule does not include insulation required for plumbing systems.

TABLE 2. Insulation Schedule

Service Designation	Location	Insulation Type ⁽¹⁾	Jacket Type	Service Temp. °F ⁽²⁾	Vapor Barrier
Exterior Chemical Pipes	Exterior	1 or 2	2	N/A	Install on Type 2 insulation
Notes:					
1. Contractor may select from options listed.					
2. Unless noted otherwise, use service temperature range provided in this table to establish insulation thickness as required by TABLE 1. Required Insulation Thicknesses.					

3.04 INSTALLATION

- A. Install insulation and jacket materials in accordance with manufacturer's written instructions.
- B. Apply insulation in smooth, clean manner with tight and finished smooth joints. Fit insulation tightly against surfaces. Insulate each continuous run of pipe with full-length sections of insulation with a single piece cut to length to complete the run of pipe. Do not use cut pieces or scraps to complete the installation.
- C. Butt longitudinal and circumferential insulation joints firmly together.
- D. Maintain the integrity of vapor barrier jacketing. Do not use staples to hold vapor barrier overlaps in place.
- E. Apply sealant or cement when previous applications of adhesives and cement have thoroughly dried.
- F. Apply insulation to permit expansion or contraction of pipelines without damage to insulation or jacketing.
- G. Fittings:
 - 1. Insulate fittings by covering with mitered sections of insulation or utilize factory-made prefabricated fitting shapes.

- H. Provide continuous insulation through and over pipe supports and provide protection saddles at supports.
- I. Extend insulation against insulation end protection shields or covers so that insulation voids do not exist and provide watertight end seals and covers where insulation terminates.
- J. Apply pre-molded pipe insulation with extended legs when used on pipe traced with either tubing or electric cable type.
- K. Thermally isolate all insulation closure locations (end caps, transitions, etc.) Type 1 or 2 jacket installation on piping with potential reach temperatures greater than 150 degrees Fahrenheit.
- L. Apply piping identification on jackets as specified in Section 40_05_00.03 - Pipe Identification - Plant.

END OF SECTION

SECTION 40_05_07.01

PIPE SUPPORTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Supports for pipe, fittings, valves, and appurtenances.

1.02 REFERENCES

- A. ASTM International (ASTM):
 1. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 2. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 3. A967 - Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
- B. Manufacturer's Standardization Society (MSS):
 1. SP-58 - Pipe Hangers and Supports - Materials, Design, and Manufacture.

1.03 SYSTEM DESCRIPTION

- A. Contractor shall provide final design for supports for all piping on this project that is 24-inches in diameter and smaller:
 1. The design of these systems shall be the product of a qualified professional engineer licensed to practice in the State of Washington retained by Contractor (hereinafter and in all referenced sections the Design Professional).
 2. The hanger and support design drawings and calculations shall be prepared and signed by the Design Professional and shall bear the Design Professional's registration seal.
 3. These requirements, however, shall not be construed as relieving Contractor of overall responsibility for this portion of the work.
- B. In some cases, pipe supports are shown on the Drawings. In other cases, they are not shown, but are required. Contractor is responsible to supply complete pipe supports whether they are shown on the Drawings or not.

1.04 DESIGN/PERFORMANCE REQUIREMENTS

- A. The pipe system drawings shall show the hanger and support locations.
- B. The Contractor shall select pipe hangers and supports as specified in this Section and elsewhere in the Specifications or Drawings. Selections shall be based upon the pipe support classifications specified in MSS-SP69, the piping insulation thickness, where applicable, and any special requirements that may be specified in other sections of the Specifications or Drawings.

- C. The Contractor shall review the piping layout in relation to the surrounding structure and adjacent piping, ductwork, electrical support systems, and equipment before selecting the type of support to be used at each hanger point.
- D. Where shown on the Drawings, supports are provided as guidance and may not meet minimum requirements. The Contractor shall provide, at no additional cost to the Owner, additional pipe supports as necessary and required by the Specifications. Supports shown on the Drawings shall be provided and shall be incorporated into the overall hanger and support system design.

1.05 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Design Professional Qualifications:
 - 1. Education, proof of registration, and previous experience in performing this type of work.
 - 2. Documentation shall be sufficient to demonstrate compliance with requirements of this Section.
- C. Calculations:
 - 1. Calculations and other information to substantiate supports meet minimum design strength requirements and seismic bracing.
 - 2. Seismic loads shall be as specified in Section 01_81_02.
 - 3. Calculations shall be sealed by the Design Professional.
- D. Product data:
 - 1. Design features.
 - 2. Load capacities.
 - 3. Material designations by UNS alloy number or ASTM Specification and Grade.
 - 4. Data needed to verify compliance with the Specifications.
 - 5. Catalog data.
 - 6. Clearly mark submittal information to show specific items, materials, and accessories or options being furnished.
- E. Shop Drawings:
 - 1. Include schedule, indicating where supports will be installed.
 - 2. Piping layout drawings with supports.
 - 3. Shop drawings shall be sealed by the Design Professional.

1.06 WARRANTY

- A. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

- A. As specified in Section 01_60_00 - Product Requirements.

2.02 MATERIALS

- A. General:
 - 1. Hot dip galvanized:
 - a. Fabricate as specified in Section 05_12_00 - Structural Steel.
 - b. Hot dip after fabrication of support in accordance with ASTM A123.
 - c. Repair galvanized surface as specified in Section 05_12_00 - Structural Steel.
 - 2. Stainless steel:
 - a. Fabricate as specified in Section 05_12_00 - Structural Steel.
 - b. Finish requirements: Remove free iron, heat tint oxides, weld scale, and other impurities, and obtain a passive finished surface.
 - c. At the shop, perform pickling and passivation on all surfaces inside and out in accordance with ASTM A380 or A967:
 - 1) Passivation treatments using citric acid are not allowed.
 - d. Field welding is prohibited unless specifically allowed by the Owner. All field welds shall be passivated.
- B. Outdoor areas: Areas exposed to the natural outdoor environment:
 - 1. Type 304 Stainless Steel.
- C. Indoor areas: Areas exposed to an indoor environment including galleries and tunnels:
 - 1. Type 304 Stainless Steel.
- D. Chemical containment areas:
 - 1. As specified in Section 40_05_07.05 – Non-Metallic Pipe Support System.
- E. Fasteners:
 - 1. As specified in Section 05_12_00 - Structural Steel.

2.03 PIPE SUPPORTS

- A. Hanger rods: Sized to match suspended pipe hanger, or as indicated on the Drawings:
 - 1. Manufacturers: One of following or equal:
 - a. For stainless steel piping:
 - 1) Bergen-Power, Figure 133.
 - 2) Nibco-Tolco, Figure 103.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 140.
 - 2) Bergen-Power, Figure 133.
 - 3) Cooper B-Line Systems, Inc., Figure B3205.
- B. Hanger rods, continuously threaded: Sized to match suspended pipe hanger, or as indicated on the Drawings:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Bergen-Power, Figure 94.
 - 2) FM Stainless Fasteners.
 - b. For steel and ductile iron piping:
 - 1) Anvil International, Figure 146.
 - 2) Bergen-Power, Figure 94.

- C. Eye bolts:
 - 1. For stainless steel piping:
 - a. Type 316 stainless steel, welded and rated equal to full load capacity of rod.
 - 2. For all other piping, unless indicated on the Drawings:
 - a. Welded and rated equal to full load capacity of rod.

- D. Welded eyebolt rod:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 101.
 - 2) FM Stainless Fasteners.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 278.
 - 2) Bergen-Power, Figure 93.
 - 3) Cooper B-Line Systems, Inc., Figure B3210.

- E. Adjustable ring hangers: MSS SP-58, Type 7 or Type 9 (system dependent):
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 1C.I.
 - 2) Bergen-Power, Figure 100SS.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 97.
 - 2) Cooper B-Line Systems, Inc., Figure B3172.

- F. Adjustable clevis hangers: MSS SP-58, Type 1:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Cooper B-Line Systems, Inc., Figure B3100 or B3102.
 - 2) FM Stainless Fasteners, Figure 60.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 260 or Figure 590.
 - 2) Bergen-Power, Figure 100.
 - 3) Cooper B-Line Systems, Inc., Figure B3100 or B3102.

- G. Adjustable clevis hangers for insulated pipe: Oversize:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 1A.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 300.
 - 2) Bergen-Power, Figure 100EL.
 - 3) Cooper B-Line Systems, Inc. Figure B3108.

- H. Single rod hangers for steam pipe: MSS SP-58, Type 43; malleable iron or steel yoke and roller hangers; swivel to allow rotation of yoke on rod:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 324.
 - 2) Cooper B-Line Systems, Inc., Figure B3110.
 - 3) FM Fasteners, Figure 81.

- b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 181.
 - 2) Cooper B-Line Systems, Inc., Figure B3110.
- I. Double rod hangers for steam pipe: MSS SP-58, Type 41:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) FM Stainless Fasteners, Figure 71.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 171.
 - 2) Cooper B-Line Systems, Inc., Figure B3114.
- J. Brackets: MSS SP-58, Type 32 with back plate; rated for 1,500 pounds:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 30M.
 - 2) Cooper B-Line Systems, Inc., Figure B3066.
 - 3) FM Stainless Fasteners, Figure 98.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 195.
 - 2) Cooper B-Line Systems, Inc., Figure B3066.
- K. Standard U-bolt: MSS SP-58, Type 24:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 110.
 - 2) Cooper B-Line Systems, Inc., Figure B3188.
 - 3) FM Stainless Fasteners, Figure 37.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 137.
 - 2) Bergen-Power, Figure 283.
 - 3) Cooper B-Line Systems, Inc., Figure B3188.
- L. Riser clamps: MSS SP-58, Type 8:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Cooper B-Line Systems, Inc., Figure B3373.
 - 2) FM Stainless Fasteners, Figure 61.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 261.
 - 2) Bergen-Power, Figure 126.
 - 3) Cooper B-Line Systems, Inc., Figure B3373.
- M. Pipe clamps: MSS SP-58, Type 4:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 4.
 - 2) Cooper B-Line Systems, Inc., Figure 3140.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 212.
 - 2) Bergen-Power, Figure 175.
 - 3) Cooper B-Line Systems, Inc., Figure B3140.

- N. Adjustable offset pipe clamp:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 4.
 - 2) Cooper B-Line Systems, Inc., Figure B3149.
 - 3) FM Stainless Fasteners, Figure 63.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 100.
 - 2) Cooper B-Line Systems, Inc., Figure B3149.
- O. Offset pipe clamp:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 8.
 - 2) Cooper B-Line Systems, Inc., Figure 3148.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 103.
 - 2) Cooper B-Line Systems, Inc., Figure B3148.
- P. Floor stand or stanchion saddles: MSS SP-58, Type 37. Provided with U-bolt hold down yokes:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 318.
 - 2) FM Stainless Fasteners, Figure 59.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 259.
 - 2) Bergen-Power, Figure 125.
 - 3) Cooper B-Line Systems, Inc., Figure B3090.
 - c. Threaded pipe stand support stanchion. Match pipe support material.
 - 1) Anvil International, Figure 63T.
 - 2) Bergen-Power, Figure 138.
 - 3) Cooper B-Line Systems Inc., Figure B3088ST.
- Q. Spring hangers:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Bergen-Power, Figure 920.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure B-268, Type G.
 - 2) Bergen-Power, Figure 920.
- R. Welded beam attachment: MSS SP-58, Type 22:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 304.
 - 2) Cooper B-Line Systems, Inc., Figure 3083.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 66.
 - 2) Bergen-Power, Figure 113A or 113B.
 - 3) Cooper B-Line Systems, Inc., Figure B3083.

- S. Heavy pipe clamp: MSS SP-58, Type 4:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 4H.
 - b. For all other piping, unless called out otherwise on the drawings:
 - 1) Anvil International, Figure 216.
 - 2) Bergen-Power, Figure 298.

- T. PTFE pipe slide assembly: MSS SP-58, Type 35 with lateral and vertical restraint:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 426.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 257, Type 3.
 - 2) Cooper B-Line Systems, Inc., Figure B3893.

- U. Anchor bolts, concrete anchors, concrete inserts, powder-actuated fasteners, and sleeve anchors: As specified in Section 05_12_00 - Structural Steel.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Support, suspend, or anchor exposed pipe, fittings, valves, and appurtenances to prevent sagging, overstressing, or movement of piping; and to prevent thrusts or loads on or against connected pumps, blowers, and other equipment.
- B. Field verify support location, orientation, and configuration to eliminate interferences prior to fabrication of supports.
- C. Carefully determine locations of inserts. Anchor to formwork prior to placing concrete.
- D. Use flush shells only where indicated on the Drawings.
- E. Do not use anchors relying on deformation of lead alloy.
- F. Do not use powder-actuated fasteners for securing metallic conduit or steel pipe larger than 1-inch to concrete, masonry, or wood.
- G. Suspend pipe hangers from hanger rods and secure with double nuts.
- H. Install continuously threaded hanger rods only where indicated on the Drawings.
- I. Use adjustable ring hangers or adjustable clevis hangers for 4-inch and smaller diameter pipe.
- J. Use adjustable clevis hangers for pipe larger than 4 inches in diameter.
- K. Secure pipes with double nutted U-bolts or suspend pipes from hanger rods and hangers:
 - 1. For stainless steel piping, use stainless steel U-bolts.

2. For all other piping, use galvanized U-bolts.
- L. Support spacing:
1. Support 2-inch and smaller piping on horizontal and vertical runs at maximum 5 feet on center, unless otherwise specified.
 2. Support larger than 2-inch piping on horizontal and vertical runs at maximum 10 feet on center, unless otherwise specified.
 3. Support exposed polyvinyl chloride and other plastic pipes at maximum 5 feet on center, regardless of size.
 4. Support tubing, PVC pipe 1-inch and smaller, copper pipe and tubing, fiber-reinforced plastic pipe, and rubber hose and tubing at intervals close enough to prevent sagging greater than 1/4-inch between supports.
 5. Do not suspend or support valves, pipe and fittings from another pipe or conduit.
- M. Install supports at:
1. Any change in direction.
 2. Both sides of flexible pipe connections.
 3. Base of risers.
 4. Floor penetrations.
 5. Connections to pumps, blowers, and other equipment.
 6. Valves and appurtenances.
- N. Securely anchor plastic pipe, valves, and headers to prevent movement during operation of valves.
- O. Anchor plastic pipe between expansion loops and direction changes to prevent axial movement through anchors.
- P. Provide elbows or tees supported from floors with base fittings where indicated on the Drawings.
- Q. Support base fittings with metal supports or when indicated on the Drawings support on concrete piers.
- R. Do not use chains, plumbers' straps, wire, or similar devices for permanently suspending, supporting, or restraining pipes.
- S. Support plumbing drainage and vents in accordance with plumbing code as specified in Section 01_41_00 - Regulatory Requirements.
- T. Supports, clamps, brackets, and portions of support system bearing against copper pipe: Copper plated, copper throughout, or isolated with neoprene or polyvinyl chloride tape.
- U. Where pipe is insulated, install over-sized supports and hangers.
- V. Install insulation shield in accordance with MSS SP-58, Type 40. Shield shall be galvanized steel unless otherwise specified or indicated on the Drawings.

- W. Install riser clamps at floor penetrations and where indicated on the Drawings.
- X. Coat support system components as specified in Section 09_96_01 - High-Performance Coatings.

END OF SECTION

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SECTION 40_05_07.03

PREFORMED CHANNEL PIPE SUPPORT SYSTEM

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Preformed channel pipe support system consisting of preformed channels, fittings, straps, and fasteners engineered to support piping.

1.02 REFERENCES

- A. American Institute of Steel Construction (AISC).
- B. American Iron and Steel Institute (AISI).
- C. Manufacturer's Standardization Society (MSS):
 - 1. SP-58 - Pipe Hangers and Supports - Materials, Design, and Manufacture.

1.03 SYSTEM DESCRIPTION

- A. Design responsibility:
 - 1. The manufacturer of the preformed channel pipe support system is responsible for the design of the support system.
 - 2. Prepare design calculations utilizing the design criteria included in these Specifications.
 - 3. Prepare detailed shop drawings illustrating the layout of the support system and identifying the components of the support system.
- B. Design criteria:
 - 1. Include live, dead, and seismic loads associated with piping, valves, and appurtenances. Consider the content of the pipes in load calculations.
 - 2. Minimum gauge thickness: 12-gauge.
 - 3. Allowable stress of channels:
 - a. Steel channels: The lesser of 25,000 pounds per square inch, or 0.66 times yield stress of steel.
 - b. Stainless steel channels: 0.66 times the yield stress of the stainless steel alloy.
 - 4. Maximum deflection: 1/240 of span.
 - 5. Allowable column loads: As recommended by manufacturer in published instruction for column's unsupported height and "K" value for calculating effective column length of not less than 1.0.
 - 6. Future loads:
 - a. Support systems indicated on the Drawings may include spaces intended to accommodate future pipes.
 - b. Assume such spaces are occupied by 6-inch diameter ductile iron pipes. Only the number of pipes that would physically fit into the space need be considered.
 - c. Include the weight of the pipe contents in determining future loads. Assume pipe contents are water.

7. Seismic design criteria: As specified in Section 01_81_02 - Seismic Design Criteria as specified for mechanical equipment.
 8. Spacing of supports: As required to comply with design requirements but not more than 5 feet.
- C. Supports below the top of walls of water bearing structures: Use Type 316 stainless steel for support system components:
1. Supports in other locations: Use hot-dipped galvanized components unless other materials are specifically indicated on the Drawings.

1.04 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data.

1.05 QUALITY ASSURANCE

- A. Design preformed channel pipe support system for loads in accordance with applicable provisions of:
 1. AISC Manual of Steel Construction.
 2. AISI Cold-Formed Steel Design Manual.
- B. Product standards:
 1. Pipe support materials: In accordance with MSS SP-58.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fabricate preformed channel pipe support system using, as a minimum, parts specified below and meeting the requirements specified under Design Criteria:
 1. Manufacturers: One of the following or equal:
 - a. Unistrut, Series P1000 or P1001; P5500 or P5501.
 - b. Allied Support Systems, Power Strut, Figure PS-200 or PS-200 2TS; PS-150 or PS-150 2TS.
 - c. Cooper Ind., B-Line, Channel Type B22 or B22A; B12 or B12A.

2.02 ACCESSORIES

- A. Preformed channel concrete inserts: Minimum 12 inches long:
 1. Manufacturers: One of the following or equal:
 - a. Unistrut, Series P-3200.
 - b. Allied Support Systems, Figure 282.
 - c. Cooper Ind., B-Line Series B32I.
- B. 90-degree angle fittings:
 1. Manufacturers: One of the following or equal:
 - a. Unistrut, P1026.
 - b. Allied Support Systems, Power Strut, P603.

- C. Pipe straps:
 - 1. For pipes 8 inches in diameter and smaller: Use 2-piece universal strap with slotted hex head screw and nut:
 - a. Manufacturers: One of the following or equal:
 - 1) Unistrut, Series P1109 through P1126.
 - 2) Allied Support Systems, PS1100.
 - 3) Cooper Ind., B-Line Series B2000.
- D. Prefabricated double channel bracket:
 - 1. Manufacturers: One of the following or equal:
 - a. Unistrut, P2542-P2546.
 - b. Cooper Ind., B-Line Series B297.
- E. Touch-up paint for galvanized surfaces:
 - 1. Manufacturers: The following or equal:
 - a. Galvinox, Galvo-Weld.
- F. Touch-up paint for painted surfaces: Same formulation as factory paint.

2.03 FABRICATION

- A. Hot-dip galvanize support system components after fabrication to required length and shape.
- B. Do not galvanize or paint stainless steel components.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install preformed channel concrete inserts for vertical support, quantity based on manufacturer's structural design calculations.
- B. Fasten preformed channel pipe supports to existing walls using Z-fittings and concrete anchors as indicated on the Drawings.
- C. Fasten preformed channel pipe supports to preformed channel concrete inserts embedded in ceiling using U-shaped fittings.
- D. Suspend threaded rods from concrete inserts embedded in ceiling. Support preformed channel pipe supports with threaded rods.
- E. Touchup cut or damaged galvanized surfaces.
- F. Prevent contact between pipes and support components of dissimilar metals. Utilize rubber coated, plastic coated, or vinyl coated components, stainless steel components, or wrap pipe with PVC or polyethylene tape.
- G. Install support as near as possible to concentrated loads.

- H. Install support within 2 feet of horizontal and vertical changes in pipe alignment.
- I. Adjust supports or install shims to obtain specified slope or elevation.

END OF SECTION

SECTION 40_05_07.05

NON-METALLIC PIPE SUPPORT SYSTEM

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Non-metallic pipe support system including the following:
 - 1. Channel framing, and components.
 - 2. Pipe clamps.
 - 3. Fittings.
 - 4. Fasteners.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. E84 - Test Method for Surface Burning Characteristics of Building Materials.

1.03 SYSTEM DESCRIPTION

- A. Design responsibility:
 - 1. The manufacturer of the non-metallic pipe support system shall be considered the designer of the support system.
 - 2. Prepare design calculations utilizing the design criteria included in these Specifications.
 - 3. Prepare detailed shop drawings illustrating the layout of the support system and identifying the components of the support system.
- B. Design requirements:
 - 1. Include live, dead, and seismic loads associated with piping, valves, and appurtenances. Consider the content of the pipes in load calculations.
 - 2. Maximum allowable deflection: 1/240 of span.
 - 3. Allowable column loads: As recommended by manufacturer in published instruction for column's unsupported height and "K" value for calculating effective column length of not less than 1.0.
 - 4. Future loads:
 - a. Support systems indicated on the Drawings may include spaces intended to accommodate future pipes.
 - b. Assume such spaces are occupied by 6-inch diameter ductile iron pipes. Only the number of pipes that would physically fit into the space need be considered.
 - c. Include the weight of the pipe contents in determining future loads. Assume pipe contents are water.
 - 5. Seismic design criteria: As specified in Section 01_81_02 - Seismic Design Criteria as specified for mechanical equipment.
 - 6. Spacing of supports: As required to comply with design requirements but not more than 5 feet.

1.04 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Shop drawings.
- C. Calculations.

1.05 QUALITY ASSURANCE

- A. Supply materials from a single manufacturer with sole responsibility for the pipe support system.
- B. The supplied system, including pipe clamps, shall be interchangeable with industry standard 1-5/8-inch steel and fiberglass channel framing systems.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Transportation, handling, storage, and installation shall be in accordance with the manufacturers printed instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. One of the following or equal:
 - 1. StrutTech.
 - 2. Unistrut.

2.02 MATERIALS

- A. Fiberglass resin: Corrosion-resistant premium grade vinylester.
- B. Injection molded components: Polyurethane thermoplastics.
- C. Flame spread of fiberglass:
 - 1. Vinylester fiberglass (Series VF): Class 1, ASTM E84.
 - 2. Polyurethane: V-O UL 94V.
- D. Physical properties of fiberglass:

	Longitudinal	Transverse
Tensile Strength	37,500 pounds per square inch, (psi)	10,000 pounds per square inch, (psi)
Tensile Modules	3.0 X 10 ⁶ psi	1.0 X 10 ⁶ psi
Flexural Strength	37,500 psi	14,000 psi
Flexural Modules	2.0 X 10 ⁶ psi	1.0 X 10 ⁶ psi

	Longitudinal	Transverse
Compressive Strength	37,500 psi	20,000 psi
Shear Strength	6,000 psi	5,500 psi
Izod Impact	30 foot-pounds per square inch	5 foot-pounds per square inch

- E. Surface veil: Fiberglass channel shall have polyester surface veil over 100 percent of the surface to provide protection against degradation from ultraviolet light.
- F. Touch-up resin:
 - 1. Manufacturers: The following or equal:
 - a. Krylon, 7006-Satin Polyurethane Clear Finish.

2.03 COMPONENTS

- A. Channel framing:
 - 1. All channel framing shall be supplied with integral notches 1-inch on center.
 - 2. Locate notches on interior flange to prevent slippage of pipe clamps and fittings after installation.
- B. Pipe clamps:
 - 1. Adjustable type: Non-metallic and non-conductive.
 - 2. Fixed type:
 - a. Pipe clamps for pipe less than 6 inches in diameter shall be non-metallic and non-conductive.
 - b. Pipe clamps for pipe equal to and greater than 6 inches in diameter shall be fiberglass.
- C. Channel fittings:
 - 1. Make fittings and post bases from glass-filled polyurethane or polyester.
- D. Fasteners:
 - 1. Make fasteners from one of the following materials:
 - a. Glass-filled polyurethane.
 - b. Vinylester fiberglass.
- E. Cushion strip:
 - 1. For solvent welded plastic pipes in elevated temperatures, use a thermoplastic elastomer, cushion wrap designed for use from -50 degrees Fahrenheit to 275 degrees Fahrenheit. Contractor to add a cushion strip at each pipe support strap that meets this criteria:
 - a. Manufacturers: One of the following or equal:
 - 1) Anvil, AS 3795.
 - 2) Unistrut, P2600 Unicushion.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Install in accordance with manufacturer's instructions, shop drawings, and as indicated on the Drawings.
2. Seal machined edges and holes with touch-up resin.

END OF SECTION

SECTION 40_05_31.01

PLASTIC PIPING AND TUBING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Plastic pipe, tubing, and fittings.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.12 - Cast Iron Threaded Drainage Fittings.
- B. ASTM International (ASTM):
 - 1. D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - 2. D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
 - 3. D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - 4. D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - 5. D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
 - 6. D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
 - 7. D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
- C. NSF International (NSF).

1.03 ABBREVIATIONS

- A. DWV: Drain, waste, and vent.
- B. ID: Inside diameter of piping or tubing.
- C. PVC: Polyvinyl chloride.

1.04 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data: As specified in Section 33_05_00.01 - Common Work Results for General Piping.
- C. Shop Drawings:
 - 1. Describe materials, pipe, fittings, gaskets, and solvent cement.

2. Installation instructions.

1.05 QUALITY ASSURANCE

- A. Plastic pipe in potable water applications: Provide pipe and tubing bearing NSF seal.
- B. Mark plastic pipe with nominal size, type, class, schedule, or pressure rating, manufacturer and all markings required in accordance with ASTM and AWWA standards.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping materials from sunlight, scoring, and distortion.
- B. Do not allow surface temperatures on pipe and fittings to exceed 120 degrees Fahrenheit.
- C. Store and handle PE pipe and fittings as recommended by manufacturer in published instructions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Extruding and molding material: Virgin material containing no scrap, regrind, or rework material except where permitted in the referenced standards.
- B. Fittings: Same material as the pipe and of equal or greater pressure rating, except that fittings used in drain, waste, and vent piping systems need not be pressure rated.
- C. Unions 2-1/2 inches and smaller: Socket end screwed unions.

2.02 PVC PIPING, SCHEDULE TYPE

- A. Materials:
 1. PVC Pipe: Designation PVC 1120 in accordance with ASTM D1785 and appendices:
 - a. Pipe and fittings: Extruded from Type I, Grade 1, Class 12454 material in accordance with ASTM D1784.
 - b. PVC Pipe: Schedule 80 unless otherwise indicated on the Drawings.
 2. Fittings:
 - a. Supplied by pipe manufacturer.
 - b. Pressure fittings: In accordance with ASTM D2466 or ASTM D2467.
 - c. DWV fittings: In accordance with ASTM D2665.
 3. Solvent cement: In accordance with ASTM D2564:
 - a. Chemical service: For CPVC or PVC pipe in chemical service, provide the following primer and cement, or equal:
 - 1) Primer: IPS Corp., Type P70.
 - 2) Cement: IPS Corp., Type 724 cement or another cement certified by the manufacturer for chemical service.

2.03 PVC TUBING FOR CHEMICAL SERVICE

- A. Materials:
 - 1. PVC tubing with encapsulated polyester reinforcement:
 - a. Tubing size: 1/2 inch ID, unless otherwise indicated on the Drawings.
 - b. Tubing fitting: Flared PFA fittings, Fit-Line FlareLINK or equal.
 - c. Pressure rating: 100 psi minimum.
 - d. Chemical compatibility: Tubing shall be compatible with 0.8 percent sodium hypochlorite solution.
 - 2. Containment pipe: 3 inch nominal pipe size, schedule 80 PVC. Refer to Pipe Schedule shown on the Drawings.

2.04 SOURCE QUALITY CONTROL

- A. PVC piping, Schedule Type:
 - 1. Mark pipe and fittings in accordance with ASTM D1785.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Where not otherwise specified, install piping in accordance with ASTM F645, or manufacturer's published instructions for installation of piping, as applicable to the particular type of piping.
 - 2. Provide molded transition fittings for transitions from plastic to metal or IPS pipe. Do not thread plastic pipe.
 - 3. Locate unions where indicated on the Drawings, and elsewhere where required for adequate access and assembly of the piping system.
- B. Installation of PVC piping, Schedule Type:
 - 1. Solvent weld joints in accordance with ASTM D2855:
 - a. For PVC pipe in chemical service use IPS Corp., Type 724 cement in accordance with manufacturer's instructions.
 - 2. Install piping in accordance with manufacturer's published instructions.

END OF SECTION

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SECTION 40_05_51.01

COMMON WORK RESULTS FOR VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Basic requirements for valves.

1.02 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. C111/A21.11 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe Fittings.
- B. ASTM International (ASTM):
 - 1. A126 - Standard Specification for Gray Iron Casting for Valves, Flanges, and Pipe Fittings.
 - 2. A480 - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
 - 3. A536 - Standard Specification for Ductile Iron Castings.
- C. NSF International (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects.
- D. Society for Protective Coatings (SSPC):
 - 1. SP7 - Brush-Off Blast Cleaning.
 - 2. SP10 - Near-White Blast Cleaning.

1.03 DESIGN REQUIREMENTS

- A. Pressure rating:
 - 1. Suitable for service under minimum working pressures of 150 pounds per square inch gauge.
- B. Valve to piping connections:
 - 1. Valves 3 inches nominal size and larger:
 - a. Above ground: Flanged ends.
 - b. Underground: Restrained mechanical joints.
 - 2. Valves less than 3 inches nominal size: Screwed ends.
 - 3. Plastic valves in plastic piping:
 - a. Up to 2.5 inches: Provide solvent or heat welded unions.

1.04 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
 - 1. Submit the following information for each valve:
 - a. Valve type, size, pressure rating, Cv factor.

- b. Coatings.
 - c. Power valve actuators:
 - 1) Information on valve actuator including size, manufacturer, model number, limit switches, mounting; and motor enclosure, seating and unseating torque coefficient, dynamic torque, and bearing friction for calculation of maximum operating torque.
 - 2) Complete wiring diagrams and control system schematics.
 - d. Manual valve actuators:
 - 1) Information on valve actuator including size, manufacturer, model number.
 - e. Certified drawings with description of component parts, dimensions, weights, and materials of construction.
 - f. Certifications of reference standard compliance:
 - 1) Submit certification that the valves and coatings are suitable in potable water applications in accordance with NSF 61.
 - g. Clearly mark submittal information to show specific items, materials, and accessories or options being furnished.
- C. Provide vendor operation and maintenance manual as specified in Section 01_78_24 - Operation and Maintenance Manuals:
- 1. Furnish bound sets of installation, operation, and maintenance instructions for each type of manual valve 4 inches in nominal size and larger, and all non-manual valves. Include information on valve operators.
- D. Provide Manufacturer's Certificate of Source Testing as specified in Section 01_75_17 - Commissioning.
- E. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01_75_17 - Commissioning.

1.05 QUALITY ASSURANCE

- A. Manufacturer qualifications:
 - 1. Valves manufactured by manufacturers whose valves have had successful operational experience in comparable service.

1.06 DELIVERY STORAGE AND HANDLING

- A. Protect valves and protective coatings from damage during handling and installation; repair coating where damaged.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Stainless steel: In accordance with ASTM A480, Type 316, or Type 304, UNS Alloy S31600 or S30400.
- B. Valve and operator bolts and nuts:
 - 1. Fabricated of stainless steel for the following installation conditions:
 - a. Submerged in water.
 - b. In an enclosed space above water.

- c. In structures containing water, below top of walls.
- d. At openings in concrete or metal decks.
- 2. Where dissimilar metals are being bolted, use stainless steel bolts with isolation bushings and washers.
- 3. Underground bolts: Low-alloy steel in accordance with AWWA C111/A21.11.
- C. Bronze and brass alloys: Use bronze and brass alloys with not more than 6 percent zinc and not more than 2 percent aluminum in the manufacture of valve parts; UNS Alloy C83600 or C92200 unless specified otherwise.
- D. Valve bodies: Cast iron in accordance with ASTM A126, Class 30 minimum or ductile iron in accordance with ASTM A536, Grade 65-45-12 minimum unless specified otherwise.

2.02 INTERIOR PROTECTIVE LINING

- A. When specified in the particular valve specification, provide valves with type of protective lining specified in the particular valve Specification.
- B. Apply protective lining to interior, non-working surfaces, except stainless steel surfaces.
- C. Lining types:
 - 1. Fusion bonded epoxy:
 - a. Manufacturers: The following or equal:
 - 1) 3-M Company, ScotchKote 134; certified to NSF 61 for drinking water use.
 - b. Clean surfaces in accordance with SSPC SP 7 or SP 10, as recommended by epoxy manufacturer.
 - c. Apply in accordance with manufacturer's published instructions.
 - d. Lining thickness: 0.010 to 0.012-inch, except that:
 - 1) Lining thickness in grooves for gaskets: 0.005-inch.
 - 2) Do not coat seat grooves in valves with bonded seat.
 - e. Quality control:
 - 1) Lining thickness: Measured with a non-destructive magnetic type thickness gauge.
 - 2) Verify lining integrity with a wet sponge-testing unit operating at approximately 60 volts, or as recommended by the lining manufacturer.
 - 3) Consider tests successful when lining thickness meets specified requirements and when no pinholes are found.
 - 4) Correct defective lining disclosed by unsuccessful tests, and repeat test.
 - 5) Repair pinholes with liquid epoxy recommended by manufacturer of the epoxy used for lining.
 - 2. High solids epoxy:
 - a. Product equivalent to high solids epoxy specified in Section 09_96_01 - High-Performance Coatings:
 - 1) Certified in accordance with NSF 61 for drinking water use.
 - 2) Interior: Coat valve interior with manufacturer's equivalent high performance high solids epoxy coating system with a certifiable performance history for the service conditions and as approved by

the Engineer. Manufacturer shall provide for approval, coating information sufficient to allow Engineer to assess equivalence to the specified high solids epoxy coating specified in Section 09_96_01 - High-Performance Coatings.

- b. Clean surfaces to meet SP-7 or SP-10, or as recommended by coating manufacturer.
- c. Quality control: After coating is cured, check coated surface for porosity with a holiday detector set at 1,800 volts, or as recommended by coating manufacturer:
 - 1) Repair holidays and other irregularities and retest coating.
 - 2) Repeat procedure until holidays and other irregularities are corrected.

2.03 UNDERGROUND VALVES

- A. Provide underground valves with flanged, mechanical, or other type of joint required for the type of pipe to which the valve is to be connected.
- B. Coating and wrapping:
 - 1. After installation, encase valves in 2 layers of polyethylene wrap as specified for ductile iron piping in Section 33_05_19 - Ductile Iron Pipe: AWWA C151 - Infrastructure:
 - a. Ascertain that polyethylene wrapping does not affect operation of valve.

2.04 VALVE BOXES

- A. Provide cast-iron valve boxes at each buried valve to access valve and valve operators.
- B. Do not support boxes on valve, valve operator, or pipe.
- C. Valve boxes shall consist of cast iron top section, cover, and lower section:
 - 1. Top section shall be Model VB2C and shall have an overall length of 18 inches.
 - 2. Cover shall be Model VB2A and shall have ears and the word WATER cast in the top.
- D. Lower section shall be Model VB1C and shall have a minimum length of twenty-four (24) inches. Manufacturer: No exceptions:
 - 1. Olympic Foundry, Inc., Seattle, WA.

2.05 VALVE STEM EXTENSION

- A. Valves with an operating nut more than 4 feet below grade shall have a valve stem extension to raise the operating nut within 28 inches of the ground surface.
- B. Valve stem extensions shall have a 2-inch square operating nut and self-centering support plate:
 - 1. Extension shall be 1 inch diameter cast or ductile iron and coated with two coats asphaltic varnish.
 - 2. Extensions shall be a minimum 1 foot in length.
 - 3. Only 1 extension per valve is permitted.

4. Operating nut and extension stem shall be welded to 1/4 inch thick round steel plate. Plate shall maintain at least 1/4 inch separation from valve box walls on all sides.
5. Centering plate shall be 4 1/4 inch diameter and have 1/8 inch minimum thickness.
6. Valve nut interface shall be 2 1/4 inch square 1/8 inch minimum thickness with two 3/8 inch allen set screws.

2.06 VALVE OPERATORS

- A. Valve operator "Open" direction: Open counterclockwise.
- B. Provide valves located below operating level or deck with extensions for key operation or floor stands and handwheels.
- C. Provide manually operated valves located not more than 6 feet above the operating level with tee handles, wrenches, or handwheels:
 1. Make the valve operator more conveniently accessible by rolling valves, located more than 5 feet but less than 6 feet above the operating level, toward the operating side.
 2. Secure tee handles and wrenches to the valve head or stem, except where a handle or wrench so secured constitutes a hazard to personnel; in which case, stow handle or wrench immediately adjacent to the valve on or in a suitable hanger, bracket, or receptacle.
- D. Fit valves located more than 6 feet above operating level with chain operated handles or valve wheels:
 1. Chains: Sufficient length to reach approximately 4 feet above the operating level.
 2. Where chains constitute a nuisance or hazard to operating personnel, provide holdbacks or other means for keeping the chains out of the way.
- E. Provide an operator shaft extension from valve or valve operator to finished grade or deck level when buried valves, and other valves located below the operating deck or level, are specified or indicated on the Drawings to be key operated; provide 2 inches square AWWA operating nut, and box and cover as specified, or a cover where a box is not required.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Preparation prior to installation:
 1. Install valves after the required submittal on installation has been accepted.
 2. Determine after flanged valves and flanged check valves are selected, the face-to-face dimensions of flanged valves and flanged check valves.
- B. Fabricate piping to lengths taking into account the dimensions of flanged valves and flanged check valves.

3.02 INSTALLATION

- A. Provide incidental work and materials necessary for installation of valves including flange gaskets, flange bolts and nuts, valve boxes and covers, concrete bases, blocking, and protective coating.
- B. Where needed, furnish and install additional valves for proper operation and maintenance of equipment and plant facilities under the following circumstances:
 - 1. Where such additional valves are required for operation and maintenance of the particular equipment furnished by Contractor.
 - 2. Where such additional valves are required as a result of a substitution or change initiated by Contractor.
- C. Valve and actuator orientation:
 - 1. Contractor shall coordinate with valve supplier final orientation of valve and actuator assembly based on Contractor's selection of equipment manufacturers and the valve and piping arrangement as indicated on the Drawings:
 - a. Contractor shall rotate valve and/or actuator mounting orientation as specified in this Section unless otherwise indicated on the Drawings.
 - 2. Install valves with their stems in vertical position above the pipe, except as follows:
 - a. Butterfly valves, gate valves aboveground, and ball valves may be installed with their stems in the horizontal position.
 - 3. Install valves so that handles clear obstructions when the valves are operated from fully open to fully closed.
- D. Place top of valve boxes flush with finished grade or as otherwise indicated on the Drawings.
- E. Valves with threaded connections:
 - 1. Install valves by applying wrench on end of valve nearest the joint to prevent distortion of the valve body.
 - 2. Apply pipe joint compound or Teflon™ tape on external (male) threads to prevent forcing compound into valve seat area.
- F. Valves with flanged connections:
 - 1. Align flanges and gasket carefully before tightening flange bolts.
 - 2. When flanges are aligned, install bolts and hand tighten.
 - 3. Tighten nuts opposite each other with equal tension before moving to next pair of nuts.
- G. Valves with soldered connections:
 - 1. Do not overheat connection to prevent damage to resilient seats and metal seat rings.
 - 2. Position valves in full open position before starting soldering procedure.
 - 3. Apply heat to piping rather than to valve body.
- H. Valves shall be installed so that the stems are vertical and centered in valve box, unless otherwise directed by the Engineer. Jointing shall conform to AWWA C600. Valves shall be installed in accordance with the details shown. Valves shall be tested with the adjacent pipeline. As specified herein, hydrostatic tests shall be conducted so as to limit the differential pressure across valves to 150 psi. If a valve

joint leaks under test, the valve shall be disconnected and reconnected, and the valve and the pipeline re-tested. If valve leaks under test, valve shall be replaced and the new valve and the pipeline re-tested.

- I. Backfill for valves and valve boxes shall be the same as specified for the adjacent pipe. Place backfill around the valve boxes and thoroughly compact to a density equal to that specified for the adjacent trench and in such manner, that will not damage or displace the valve box from proper alignment or grade.
- J. Misaligned valve boxes shall be excavated, plumbed, backfilled and the valve and adjacent pipeline re tested at the Contractor's expense. A minimum eight (8) inch overlap between the upper and lower valve boxes will be required to ensure the valve box height can be adjusted during future overlays.
- K. When abandoning existing gate valves on a tee, the Contractor is to remove the valve and install a blind flange; if the tee is in poor quality the city may require the contractor to completely cut out the existing valve and replace with spool and sleeves. If the valve is on a section of water main that is being abandoned, the contractor shall close the existing valve and remove the valve box and lid to one (1) foot below grade. Replace the lid and add PVC marker that reads "Abandoned Gate Valve." Valves from the abandoned water mains shall be removed and return to City storage yard as salvage.

3.03 FIELD APPLIED COATING OF VALVE EXTERIOR

- A. Match color and be compatible with manufacturer's coating system and as specified in Section 09_96_01 - High-Performance Coatings:
 - 1. When shop applied finish coating matches field applied coating on adjacent piping, touch up shop coating in damaged areas in accordance with instructions recommended by the paint manufacturer.
 - 2. When shop applied coating does not match field coating on adjacent piping, or when damage has occurred to the shop applied coating that requires more than touchup, blast clean valve surfaces or utilize other surface preparation recommended by the manufacturer of the coating material and apply the coating system used for coating adjacent piping.

3.04 COMMISSIONING

- A. As specified in Section 01_75_17 - Commissioning and this Section.
- B. Manufacturer services from each manufacturer for all valves supplied:
 - 1. Provide Manufacturer's Certificate of Source Testing.
 - 2. Provide Manufacturer's Certificate of Installation and Functionality Compliance.
- C. As specified elsewhere for specific valve types, sizes or actuators.
 - 1. Source testing.
 - 2. Manufacturers on site services for Owner Training, Installation Testing, Functional Testing, and during the Process Operational Period.

END OF SECTION

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SECTION 40_05_52

SPECIALTY VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Specialty valves.
- B. As specified in Section 40_05_51.01 - Common Work Results for Valves.

1.02 REFERENCES

- A. American Society of Civil Engineers (ASCE):
 - 1. 25 - Earthquake-Actuated Automatic Gas Shutoff Devices.
- B. American Society of Mechanical Engineers (ASME):
 - 1. B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
- C. American Water Works Association (AWWA):
 - 1. C511 - Standard for Reduced Pressure-Principle Backflow-Prevention Assembly.
 - 2. C800 - Underground Service Line Valves & Fittings (Also Included: Collected Standards For Service Line Materials).
- D. ASTM International (ASTM):
 - 1. A48 - Standard Specification for Gray Iron Castings.
 - 2. A126 - Standard Specification for Gray Iron Casting for Valves, Flanges, and Pipe Fittings.
 - 3. A276 - Standard Specification for Stainless Steel Bars and Shapes.
 - 4. A536 - Standard Specification for Ductile Iron Castings.
 - 5. B584 - Standard Specification for Copper Alloy Sand Castings for General Application.
- E. National Electrical Manufacturers Association (NEMA):
 - 1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

1.03 DEFINITIONS

- A. NEMA Type 4 enclosure in accordance with NEMA 250.

1.04 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data: As specified in Section 40_05_51.01 - Common Work Results for Valves.
- C. Commissioning submittals:
 - 1. Backflow preventer certification.

2. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01_75_17 - Commissioning.

1.05 WARRANTY

- A. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 BACKFLOW PREVENTERS

- A. Manufacturers: One of the following or equal:
 1. Febco backflow prevention:
 - a. Model LF860 all sizes.
 2. Zurn/Wilkins:
 - a. Model 975XL for 1/2-inch through 2-inch.
 3. Watts regulator: Series LF909.
- B. Design: Reduced pressure chamber type in accordance with AWWA C511.
- C. Include shutoff valves at each end of backflow preventer with properly located test cocks.
- D. Valve manufacturer and model shall be approved for use by the Washington State Department of Health, Olympia, Washington and be listed in the USC-Approved Assemblies List.
- E. Shutoff valves:
 1. Backflow preventers 2-inch and smaller: Provide with full-port, quarter turn, resilient seated ball valves.

EXECUTION

2.02 INSTALLATION

- A. Install as specified in Section 40_05_51.01 - Common Work Results for Valves in accordance with manufacturer's published instructions.
- B. Install with a minimum clearance of 12 inches and with maximum clearance of 30 inches between the relief port and the floor or finished grade or top of containment wall.
- C. Backflow preventers:
 1. Install with a minimum clearance of 12 inches and with maximum clearance of 30 inches between the relief port and the floor or finished grade or top of containment wall.
 2. Install with sufficient side clearance for access for testing and maintenance.

2.03 COMMISSIONING

- A. As specified in Section 01_75_17 - Commissioning and this Section.
- B. Manufacturer services:
 - 1. Provide certificates:
 - a. Manufacturer's Certificate of Installation and Functionality Compliance.
- C. Functional testing:
 - 1. Backflow preventer:
 - a. Test witnessing: Witnessed.
 - b. Conduct pressure and leak test as specified in Section 40_05_51.01 - Common Work Results for Valves.
 - c. Backflow preventer certification.

END OF SECTION

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SECTION 40_05_57.13

MANUAL ACTUATORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Valve and gate actuators.
 - 2. Handwheel actuators.
 - 3. Floor stands.
 - 4. Accessory equipment.

1.02 REFERENCES

- A. Aluminum Association (AA):
 - 1. DAF-45 - Designation System for Aluminum Finishes.
- B. American Water Works Association (AWWA).
- C. National Electrical Manufacturers Association (NEMA):
 - 1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).
- D. National Electrical Code (NEC).

1.03 DEFINITIONS

- A. NEMA:
 - 1. Type 4X enclosure in accordance with NEMA 250.
 - 2. Type 7 enclosure in accordance with NEMA 250.

1.04 SUBMITTALS

- A. Shop drawings: Include shop drawings and product data with associated gate or valve as an integrated unit.

1.05 QUALITY ASSURANCE

- A. Provide valve actuators integral with valve or gate, except for valve actuators utilizing T-wrenches or keys, and portable gate actuators intended to operate more than 1 valve.
- B. Provide similar actuators by 1 manufacturer.
- C. Provide motorized actuators by 1 manufacturer.

1.06 MAINTENANCE

- A. Extra materials:
 - 1. Key operated valve keys or wrenches: Furnish a minimum 4 keys with 4-foot shafts and 3-foot pipe handles or wrenches with 4-foot shafts and 3-foot handles for operating key operated valves.

PART 2 PRODUCTS

2.01 VALVE AND GATE ACTUATORS

- A. Valve actuators:
 - 1. Motorized actuators are specified in Sections 40_05_57.24 - Electric Motorized Actuators.
 - 2. Manual actuators:
 - a. Material: Type 316 stainless steel.
 - b. Design: Hand lever.
 - c. Spring release handle: 12-inch.
 - d. Notch plate: 10 position.
 - e. Secure with mounting bolts.
 - f. Locking device so that valve can be locked in any position with a wing nut.
- B. Position indicators:
 - 1. For all aboveground worm gear or traveling nut manual actuators, provide position indication on the actuator enclosure.
 - 2. Tail rods on hydraulic cylinders, or dial indicators with clear full-open and closed position indicators, calibrated in number of turns or percentage of opening.
- C. Manual or power actuator size:
 - 1. Sized to deliver maximum force required under most severe specified operating condition, including static and dynamic forces, seat and wedge friction, and seating and unseating forces with safety factor of 5, unless otherwise specified.
- D. Actuator size: Capable of supporting weight of suspended shafting unless carried by bottom thrust bearings; shaft guides with wall mounting brackets.
- E. Provisions for alternate operation: Where specified or indicated on the Drawings, position and equip handwheel operated geared valve actuators for alternate operation with tripod mounted portable gate actuators.
- F. Operation: Counterclockwise to open with suitable and adequate stops, capable of resisting at least twice normal operating force to prevent overrun of valve or gate in open or closed position.
- G. Open direction indicator: Cast arrow and legend indicating direction to rotate actuator on handwheel, chain wheel rim, crank, or other prominent place.
- H. Buried actuator housing: Oil and watertight, specifically designed for buried service, factory packed with suitable grease, completely enclosed space between actuator

housing and valve body so that no moving parts are exposed to soil; provide actuators with 2-inch square AWWA operating nut.

- I. Worm gear actuators: Provide gearing on worm gear actuators that is self-locking with gear ratio such that torque in excess of 160 foot-pounds will not need to be applied to operate valve at most adverse conditions for which valve is designed.
- J. Traveling nut actuators: Capable of requiring maximum 100 foot-pounds of torque when operating valve under most adverse condition; limit stops on input shaft of manual actuators for fully open and closed positions; non-moving vertical axis of operating nut when opening or closing valve.

2.02 HANDWHEEL ACTUATORS

- A. Manufacturers: One of the following or equal:
 - 1. Rodney Hunt Co.
 - 2. Waterman Industries, Inc.
- B. Coating: Handwheel as specified in Section 09_96_01 - High-Performance Coatings.
- C. Bearings above and below finished threaded bronze operating nut: Ball or roller.
- D. Wheel diameter: Minimum 24 inches.
- E. Indicator: Counterclockwise opening with arrow, and word OPEN cast on top of handwheel indicating direction for opening.
- F. Pull to operate: Maximum 40 pounds pull at most adverse design condition.
- G. Stem travel limiting device: Setscrew locked stop nuts above and below lift nut.
- H. Grease fittings: Suitable for lubrication of bearings.

2.03 FLOOR STAND

- A. Manufacturers: One of the following or equal:
 - 1. Rodney Hunt Co.
 - 2. Waterman Industries, Inc.
- B. Floor stand assemblies: Heavy-duty cast-iron, suitable for mounting specified actuator.

2.04 ACCESSORY EQUIPMENT

- A. Stems: Stainless steel; sized to match output of actuator; minimum gate or valve operating stem diameter; maximum 200 slenderness ratio.
- B. Stem couplings: Stainless steel; internally threaded to match stem; lockable to stem by set screw.
- C. Stem guides: Cast-iron with silicon bronze bushing; maximum 200 slenderness ratio; capable of being mounted with wall bracket; adjustable in 2 directions.

- D. Stem stuffing boxes: Cast-iron, with adjustable gland and packing.
- E. Fasteners: Type 316 stainless steel.
- F. Anchor bolts: Type 316 stainless steel.
- G. Geared valve actuators: Provided with cut gears, either spur or worm; sized to operate valves at most adverse design condition; with maximum 40-pound pull at handwheel or chain wheel rim.
- H. Accessory equipment for valves and gates requiring remote actuators: Operating stems, stem couplings, stem guides, and stem stuffing boxes.

PART 3 EXECUTION

3.01 INSTALLATION

- A. After installation of gate and stem covers, mark stem covers at point where top of stems are at full-open position and at closed position.
- B. Attach floor stand to structure with anchor bolts.
- C. Install stem stuffing boxes where operating stems pass through intermediate concrete floor slabs.

3.02 SCHEDULES

- A. Geared actuators: Provide geared actuators for following valves:
 - 1. Butterfly valves larger than 6 inches, nominal size, on liquid service.
- B. Handwheel actuators: Provide handwheel actuators for valves mounted 6 feet or less above floors.

END OF SECTION

SECTION 40_05_57.24

ELECTRIC ACTUATORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Electric motor-driven actuators for valves.

1.02 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. C504 - Standard for Rubber-Seated Butterfly Valves.
 - 2. C542 - Standard for Electric Motor Actuators for Valves and Slide Gates.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

1.03 DEFINITIONS

- A. NEMA:
 - 1. Type 4X enclosure in accordance with NEMA 250.

1.04 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures and Section 46_05_10 - Common Work Results for Mechanical Equipment.
- B. Provide a complete list/schedule of all actuators being provided with their associated tag names as indicated on the design drawings and/or specifications, service process area and the size of the valve they are actuating.
- C. Product data:
 - 1. Electrical ratings:
 - a. Voltage and number of phases.
 - b. Starting and running current.
 - c. Voltage levels and source for control and status.
 - 2. Description of integral control interface.
 - 3. Remote control station components.
 - 4. Environmental ratings, including NEMA enclosure rating and submergence capabilities.
 - 5. Gear ratios for both manual and motorized actuation.
 - 6. Opening and closing directions.
 - 7. Allowable starts per hour.
 - 8. List of all included options and accessories.
 - 9. Full travel times.
 - 10. Gearbox data including gear ratio, and gearbox efficiency.

- D. Shop drawings:
 - 1. Wiring diagrams:
 - a. Include all options and expansion cards furnished with each actuator.
 - 2. Dimensioned drawings of each valve and actuator combination.
 - 3. Dimensioned drawings of each valve gearbox.
 - 4. Electric motor data.
- E. Calculations:
 - 1. Operating torque.
 - 2. Maximum torque calculations for seating and unseating.
 - 3. Maximum operating torque at starting and normal operation.
 - 4. Signed by Professional Engineer.
- F. Provide draft vendor operation and maintenance manual as specified in Section 01_78_24 - Operation and Maintenance Manuals:
 - 1. Include a list of all configurable parameters, and the final values for each.
 - 2. Include a troubleshooting chart covering the complete valve and controls/electrical power systems, showing description of trouble, probable cause, and suggested remedy.
- G. Commissioning submittals:
 - 1. Provide Manufacturer's Certificate of Source Testing as specified in Section 01_75_17 – Commissioning:
 - a. Affidavit in accordance with AWWA C542.
 - 2. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01_75_17 - Commissioning.
- H. Project closeout documents:
 - 1. Provide final vendor operation and maintenance manual as specified in Section 01_78_24 - Operation and Maintenance Manuals.

1.05 WARRANTY

- A. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers for chemical lines 1 inch and smaller:
 - 1. The following or equal:
 - a. Asahi America:
 - 1) Series 94.
- B. Manufacturers for lines 4 inch and larger:
 - 1. One of following or equal:
 - a. Rotork Controls Inc. IQ3 Range:
 - 1) IQ for multi-turn applications.
 - b. Limitorque Corp.:
 - 1) Accutronix MX for multi-turn applications.

2.02 CHARACTERISTICS FOR ACTUATORS ON LINES 1 INCH AND SMALLER

- A. Actuators for valves 3 inches and smaller:
 - 1. Provide actuators complete and operable with all components and accessories required for operation.
 - 2. Power supply:
 - a. Valve motion independent of power supply phase rotation.
 - b. 120 VAC single phase.
 - 3. Size actuator to move valves from full open to closed position within the time indicated in the Motorized Actuator Schedule:
 - 4. For all outdoor or vault installations, provide an integral anti-condensation heater when available as an option.
 - 5. Control inputs:
 - a. Capable of using discrete 120 VAC.
 - b. Controls the valve when local-stop-remote is in REMOTE.
 - c. Provide the following inputs at the actuator:
 - 1) OPEN.
 - 2) CLOSE.
 - 6. Status outputs:
 - a. Dry contact outputs configured for the functions indicated on the Drawings. Provide the following outputs for all actuators:
 - 1) FULLY CLOSED.
 - 2) FULLY OPEN.
 - 3) REMOTE.
 - b. All output contacts rated for 5 amps, 120 VAC.
 - 7. Materials:
 - a. Construct motorized actuators of materials suitable for the environment in which the valve or gate is to be installed.
 - 8. Components:
 - a. Motors:
 - 1) Torque ratings equal to or greater than that required for valve seating and dynamic torques with a 25 percent factor of safety.
 - 2) Rated for operating under the following conditions without exceeding temperature limits with ambient temperature of 40 degrees Celsius:
 - a) Continuous operation for 15 minutes or twice the open-to-close operating time (whichever is greater) at normal operating torque or 33 percent of maximum torque (whichever is greater).
 - b) 60 starts per hour minimum for open/close service.
 - b. Enclosures:
 - 1) Actuator housing ratings as indicated in the Motorized Actuator Schedule.
 - 2) Stainless steel external fasteners.
 - c. Manual actuation:
 - 1) Declutchable manual override handle.
 - d. Gearing: Self-locking, high-alloy steel gears.

2.03 CHARACTERISTICS FOR ACTUATORS ON LINES 4 INCHES AND LARGER

- A. Provide actuators complete and operable with all components and accessories required for operation.

- B. Power supply:
1. Voltage and phases as indicated in the Motorized Actuator Schedule.
 2. Valve or gate motion independent of power supply phase rotation.
 3. Provide an internal backup power source or mechanical indicator to maintain settings and track valve position when main power is off.
 4. The actuators shall incorporate all major components such as the motor, starter, local controls, terminals, etc. housed within a self-contained, sealed enclosure.
- C. Size actuator to move gates or valves from full open to closed position within the time indicated in the Motorized Actuator Schedule:
1. If an operating time is not indicated on the Motorized Actuator Schedule, size the actuator to move gates or valves at minimum 12 inches per minute under maximum load. Measure rate of closure for valves at maximum diameter of disc, plug, or ball.
 2. Size actuators so that gear boxes are not required where possible.
- D. Control interface:
1. Configuration:
 - a. Provide a non-intrusive, non-contacting interface for configuring all input and output settings, control values, ranges, torque switch settings, valve positions switch settings, and options:
 - 1) Configurable from a handheld configuring tool or input devices on the actuator.
 2. Local interface, integral to actuator:
 - a. Non-intrusive, non-contacting selector switches:
 - 1) LOCAL-STOP-REMOTE:
 - a) Motor actuator operation is prevented with the switch in STOP.
 - 2) OPEN-CLOSE:
 - a) Controls the valve when LOCAL-STOP-REMOTE is in LOCAL.
 - b) Spring return to center.
 - c) Configurable between maintained (actuator runs until end of travel, high torque, or a LOCAL-STOP-REMOTE is switched to STOP) and momentary (actuator stops when lever is released).
 - b. Local display:
 - 1) Valve fully open and fully closed indicators.
 - 2) Numerical display showing actual valve or gate position in percent of travel.
 3. Control inputs:
 - a. Capable of using 120 VAC or 24 VDC inputs.
 - b. Controls the valve when LOCAL-STOP-REMOTE is in REMOTE.
 - c. Isolated inputs capable of operating from external control voltage source or internal power supply:
 - 1) Furnish 120 VAC or 24 VDC control power supplies within the actuator.
 - d. Provide the following inputs:
 - 1) OPEN.
 - 2) CLOSE.
 - 3) STOP.
 - e. OPEN and CLOSE inputs configurable between maintained (actuator runs until end of travel, high torque, or a STOP input) and momentary (actuator stops when command is removed).

4. Status outputs:
 - a. Monitor relay output: Dry contact, normally closed, opens when actuator is not in REMOTE or in the event of any internal fault or alarm condition.
 - b. Dry contact outputs configured for the functions indicated on the Drawings. Provide the following outputs for all actuators:
 - 1) Fully closed.
 - 2) Fully open.
 - 3) LOCAL-STOP-REMOTE in REMOTE position.
 - 4) Faults.
 - c. All output contacts rated for 5 amps, 120 VAC, and 24 VDC.

E. Features:

1. Time delay on reversal: Incorporate time delay between stopping actuator and starting in opposite direction to limit excessive current, torque, and heating from instantaneous reversal.
2. Data logging:
 - a. Store diagnostic data and reference data.
 - b. Time-stamped historical operating data, including number of operations and most recent operations.
3. Provide display of logged data on the actuator, or provisions to download to a personal computer.

F. Materials:

1. Construct motorized actuators of materials suitable for the environment in which the valve or gate is to be installed.

G. Components:

1. Motors.
2. Specifically designed for valve actuator service with high starting torque, totally enclosed non-ventilated construction.
3. Torque ratings equal to or greater than that required for valve seating and dynamic torques with a 25 percent factor of safety:
 - a. Design requirements for rubber-seated AWWA butterfly valves:
 - 1) Design actuators for maximum gate or valve operating torque, in accordance with and using safety factors required in AWWA C504 and AWWA C542:
 - a) Valve actuator torque requirement for open-close service: Not less than the required valve-seating and dynamic torques under design operating conditions in accordance with AWWA C504.
 - b) Valve actuator torque requirement for modulating service: Not less than twice the required valve dynamic torque under design operating conditions in accordance with AWWA C504.
4. Capable of being removed and replaced without draining the actuator gear case.
5. Motor bearings shall be amply proportioned of the anti-friction type and permanently lubricated.
6. Rated for operating under the following conditions without exceeding temperature limits with ambient temperature of 40 degrees Celsius:
 - a. Continuous operation for 15 minutes or twice the open-to-close operating time (whichever is greater) at normal operating torque or 33 percent of maximum torque (whichever is greater).

- b. 60 starts per hour for open/close service or 1,200 starts per hour for modulating service.
- 7. Provide the following motor protection features:
 - a. Jammed valve (no valve motion detected through a time delay).
 - b. High motor temperature (sensed by an embedded thermostats).
 - c. High torque.
 - d. Single phasing protection.
- H. Enclosures:
 - 1. Actuator housing ratings as indicated in the Motorized Actuator Schedule.
 - 2. Stainless steel external fasteners.
 - 3. Provide o-ring seals for each of the following areas:
 - a. Between the terminal compartment and the internal electrical elements.
 - b. Between the mechanical and electrical portions to protect from the ingress of oil, and to protect the mechanical components of oil from dust and moisture when the electrical terminal is open.
 - 4. Provide the following minimum enclosure ratings:
 - a. NEMA Type 4X enclosure for general applications.
- I. Position sensing:
 - 1. Electronic and adjustable using a solid-state encoder wheel:
 - a. Mechanical limit switches and potentiometers are not acceptable.
 - 2. Capable of retaining position and monitoring valve or gate motion when valve is manually actuated and when main power is not present.
 - 3. Valve range and position switch outputs field adjustable.
- J. Torque sensing:
 - 1. Torque shutdown setting: 40 percent to 100 percent rated torque:
 - a. Adjustable in 1 percent increments.
 - 2. Capable of interrupting control circuit during both opening and closing and when valve torque overload occurs.
 - 3. Independent of variations in frequency, voltage, or temperature.
 - 4. Provide a temporary inhibit of the torque sensing system during unseating or during starting in mid-travel against high inertia loads.
 - 5. Provide visible verification of torque switch status without any housing disassembly.
- K. Manual actuators:
 - 1. Hand wheel for manual operation:
 - a. Maximum 80-pound pull on rim when operating gate or valve under maximum load.
 - b. Provide pull chain when motorized actuator is located more than 6 feet above floor surface:
 - 1) Chain shall be of sufficient length to reach approximately 4 feet above the operating level.
 - 2) Where the chain obstructs an aisle or walkway, provide holdback or other means to ensure chain does not create a nuisance or hazard to operating personnel.
 - 2. Declutch lever: Padlockable, capable of mechanically disengaging motor and related gearing and freeing hand wheel for manual operation.

- L. Gearing: Hardened alloy steel spur or helical gears and self-locking, alloy bronze worm gear set:
 - 1. Accurately cut to ensure minimum backlash.
- M. Bearings:
 - 1. Anti-friction bearing with caged balls or rollers throughout.
 - 2. Sealed-for-life type thrust bearings housed in a separate thrust base.
- N. Drive bushing:
 - 1. Easily detachable for machining to suit the valve stem or gearbox input shaft.
 - 2. Positioned in a detachable base of the actuator.
- O. Lubrication:
 - 1. Provide totally enclosed actuator gearing with oil or grease filled gear case suitable for operation at any angle.
 - 2. Actuators requiring special or exotic lubricants are not acceptable.

2.04 ACCESSORIES

- A. Software:
 - 1. Furnish PC-based diagnostic and configuration software to display diagnostic data and configure actuators.
 - 2. Provide software communications to the valve actuator:
 - a. Provide all accessories and drivers required for operation and communications with a standard personal computer running Microsoft Windows.
- B. Termination module cover:
 - 1. For actuators on a valve network, provide a means to keep the valve network in service, in the event where the actuator must be removed.
 - 2. Provide sunshades for all outdoor installations of remote control stations that use an LCD or similar screen. Regular pushbutton, sector switches, and pilot light control stations will not require a sunshade.

2.05 SPARE PARTS AND SPECIAL TOOLS

- A. As specified in Section 01_60_00 - Product Requirements.
- B. Spare parts:
 - 1. Provide the following (minimum 10 percent of total number of actuators of each model type furnished, but not less than 1 for each model of actuator furnished):
 - a. Stem nut.
 - b. Worm shaft subassembly.
 - c. Drive sleeve subassembly.
 - d. Complete actuator seal kit.
 - e. Actuator gearbox oil (sufficient quantity to fill 4 gearboxes).
 - f. Encoder.
 - g. Control module.
 - 2. Provide 1 spare motor for each size motor furnished.

- C. Setting tool:
 - 1. If required for setting or configuring the actuator, provide a handheld setting tool. Provide a handheld setting tool capable of non-intrusive calibration and interrogation of the actuator:
 - a. Capable of communicating with PC-based configuration software, and transferring the following in either direction between the computer and programmer and setting tool, and between the setting tool and actuator.
 - b. Actuator configurations:
 - 1) Capable of storing up to 10 different configurations.
 - c. Diagnostic data:
 - 1) Capable of storing 4 complete sets of diagnostic data.

PART 3 EXECUTION

3.01 GENERAL

- A. As specified in Section 46_05_10 - Common Work Results for Mechanical Equipment.
- B. Position visual indicators so that they are most easily visible.

3.02 COMMISSIONING

- A. As specified in Section 01_75_17 - Commissioning, Section 46_05_94 - Mechanical Equipment Testing, and this Section.
- B. Manufacturer services:
 - 1. Provide certificates:
 - a. Manufacturer's Certificate of Source Testing:
 - 1) Proof-of-Design and Performance Test Reports in accordance with AWWA C542.
 - b. Manufacturer's Certificate of Installation and Functionality Compliance.
 - 2. Manufacturer's Representative on-site requirements:
 - a. Installation: 1 trip, 1-day minimum.
 - b. Functional testing: 1 trip, 1-day minimum.
 - 3. Training:
 - a. Maintenance: 2 hours per session, 2 sessions.
 - b. Operation: 2 hours per session, 2 sessions.
- C. Source testing:
 - 1. Design and Performance Test Reports in accordance with AWWA C542.
 - 2. Test each actuator with a simulated load:
 - a. Simulate a typical valve load.
 - 3. Electrical Instrumentation and Controls:
 - a. Test witnessing: not witnessed.
 - b. Conduct testing as specified in Section 40_90_00 - Instrumentation and Controls.
- D. Functional testing:
 - 1. Installed actuator:
 - a. Test witnessing: Witnessed.
 - b. Conduct Level 2 General Equipment Performance Tests.

- c. Conduct Level 2 Vibration Tests.
- d. Conduct Level 2 Noise Tests.
- 2. Electrical Instrumentation and Controls:
 - a. Test witnessing: Witnessed.
 - b. Conduct testing as specified in Section 40_90_00 - Instrumentation and Controls.

3.03 MOTORIZED ACTUATOR SCHEDULE

- A. Provide all actuators indicated on the Drawings.

END OF SECTION

MOTORIZED ACTUATOR SCHEDULE

Item	Reference DWG	Type	Size	Actuator Type	NEMA Rating	Voltage/Phase/Hz	Notes	Open Time	Controls
Canyon Line Isolation Valve		BFV	24"	O/C	4X	480/3/60		30 s	D-O/C
Canyon Line Pumped Zone Valve		BFV	16"	O/C	4X	480/3/60		30 s	D-O/C
NaOCI Tank 1 Discharge Valve		BV	3/4"	O/C	4X	120/1/60	1	5 s	D-O/C
NaOCI Tank 2 Discharge Valve		BV	3/4"	O/C	4X	120/1/60	1	5 s	D-O/C
Feed Pump 1/2 Crossing Valve		BV	1/2"	O/C	4X	120/1/60	1	5 s	D-O/C
Feed Pump 2/3 Crossing Valve		BV	1/2"	O/C	4X	120/1/60	1	5 s	D-O/C
Canyon Line Cl2 Injection 1		BV	1/2"	O/C	4X	120/1/60	1	5 s	D-O/C
Canyon Line Cl2 Injection 2		BV	1/2"	O/C	4X	120/1/60	1	5 s	D-O/C
Canyon/SPU Line Injection		BV	1/2"	O/C	4X	120/1/60	1	5 s	D-O/C
SPU Line Cl2 Injection		BV	1/2"	O/C	4X	120/1/60	1	5 s	D-O/C
North Reservoir Cl2 Injection		BV	1/2"	O/C	4X	120/1/60	1	5 s	D-O/C
South Reservoir Cl2 Injection		BV	1/2"	O/C	4X	120/1/60	1	5 s	D-O/C

Notes:

- (1) Provide actuators with remote control station.
- (2) New motorized actuator to be installed on existing equipment. Field verify characteristics prior to sizing motor actuator.

SECTION 40_05_63

BALL VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Ball valves.
- B. As specified in Section 40_05_51.01 - Common Work Results for Valves.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.
- B. American Water Works Association (AWWA):
 - 1. C507 - Standard for Ball Valves 6 Inch Through 48 Inch.
- C. ASTM International (ASTM):
 - 1. A48 - Standard Specification for Gray Iron Castings.
 - 2. A216 - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
 - 3. A351 - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.

1.03 SYSTEM DESCRIPTION

- A. General: Unless otherwise indicated on the Drawings use:
 - 1. Metal body ball valves on metallic pipelines.
 - 2. Plastic body ball valves on plastic pipelines.
- B. Do not use metal body ball valves in sodium hypochlorite systems.

1.04 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data: As specified in Section 40_05_51.01 - Common Work Results for Valves:
 - 1. Operation and maintenance manual.
- C. Commissioning submittals:
 - 1. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01_75_17 - Commissioning.

1.05 WARRANTY

- A. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 METAL BODY BALL VALVES, LESS THAN 6-INCH SIZE

- A. Manufacturers: One of the following, or equal:
 - 1. Conbraco Industries, Inc., Apollo Valves.
 - 2. Flow-Tek, Inc.
 - 3. Metso Automation/Jamesbury.
 - 4. NIBCO, Inc.
- B. General:
 - 1. Type: Non-lubricated, full port and capable of sealing in either direction.
 - 2. End connections:
 - a. Threaded or solder ends for sizes 3-inch and smaller.
 - b. Class 150 flanged for sizes larger than 3 inches:
 - 1) Flanges: In accordance with ASME B16.1 standards.
 - 3. Stem packing: Manually adjustable while valve is under pressure.
 - 4. Shafts:
 - a. Rigidly connected to the ball by a positive means:
 - 1) Design connection to transmit torque equivalent to at least 75 percent of the torsional strength of the shaft.
 - 5. Handles: Stainless steel latch lock handle with vinyl grip and stainless steel nut designed to open and close the valve under operating conditions.
 - 6. Temperature limits: Suitable for operation between minus 20 and 350 degrees Fahrenheit.
- C. Materials:
 - 1. Valves in copper lines: Bronze body.
 - 2. Valves in steel and ductile iron piping: Ductile iron or cast steel body.
 - 3. Ball: Type 304 or 316 stainless steel.
 - 4. Seats: PTFE.
 - 5. Stem seals: PTFE or Viton™.
 - 6. Bearings: Self-lubricated, corrosion resistant material that will not contaminate potable water.

2.02 PLASTIC BODY BALL VALVES

- A. Manufacturers: One of the following or equal:
 - 1. Asahi America.
 - 2. Chemtrol Division, NIBCO, Inc.
 - 3. Georg Fischer Piping Systems.
 - 4. Hayward Flow Control.
 - 5. Plast-O-Matic Valves, Inc.
- B. General:
 - 1. Type: Non-lubricated and capable of sealing in either flow direction.
 - 2. End connections: True union; solvent or heat welded to piping.

3. Operator handle: Lever or electric actuator where indicated on the Drawings.
 4. Provide vented ball valves for sodium hypochlorite service.
- C. Materials:
1. Body: Polyvinyl chloride (PVC).
 2. Ball: Polyvinyl chloride (PVC).
 3. Seats: PTFE (Teflon™).
 4. O-rings: FKM (Viton™).

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Install each type of valve in accordance with manufacturers' printed instructions.
- B. Special techniques:
1. PVC ball valves for hypochlorite service:
 - a. Provide valve with factory drilled 0.125-inch hole in the upstream side of the ball.
 - b. Provide an engraved plastic tag permanently attached to the valve stem stating, "One side of ball drilled for hypochlorite service".

3.02 COMMISSIONING

- A. As specified in Section 01_75_17 - Commissioning and this Section.
- B. Manufacturer services:
1. Provide certificates:
 - a. Manufacturer's Certificate of Installation and Functionality Compliance.
- C. Functional testing:
1. Valves:
 - a. Test witnessing: Witnessed.
 - b. Conduct pressure and leak test, as specified in Section 40_05_00.09 - Piping Systems Testing.

END OF SECTION

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SECTION 40_05_64

BUTTERFLY VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Butterfly valves:
 - 1. As specified in Section 40_05_51.01 - Common Work Results for Valves.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Classes 25, 125 and 250.
 - 2. B16.5 - Pipe Flanges and Flanged Fittings, NPS 1/2 through NPS 24.
- B. American Water Works Association (AWWA):
 - 1. C110 - Standard for Ductile-Iron and Gray-Iron Fittings.
 - 2. C504 - Rubber-Seated Butterfly Valves.
 - 3. C540 - Standard for Power-Actuating Devices for Valves and Sluice Gates.
 - 4. C550 - Protective Interior Coatings for Valves & Hydrants.
 - 5. C606 - Standard for Grooved and Shouldered Joints.
- C. ASTM International (ASTM):
 - 1. A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. A216 - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for Higher-Temperature Service.
 - 3. A276 - Standard Specification for Stainless Steel Bars and Shapes.
 - 4. A351 - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
 - 5. A395 - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
 - 6. A479 - Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
 - 7. A515 - Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate - and Higher-Temperature Service.
 - 8. A516 - Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower-Temperature Service.
 - 9. A536 - Standard Specification for Ductile Iron Castings.
 - 10. A564 - Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
 - 11. A743 - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
 - 12. A890 - Standard Specification for Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex (Austenitic/Ferritic) for General Application.

13. B462 - Standard Specification for Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N10362, UNS N06686, UNS N08020, UNS N08024, UNS N08026, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N10629, UNS N08031, UNS N06045, UNS N06025, UNS R20033 Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service.
 14. B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
 15. B691 - Standard Specification for Iron-Nickel-Chromium-Molybdenum Alloys (UNS N08366 and UNS N08367) Rod, Bar, and Wire.
 16. D429 - Standard Test Methods for Rubber Property-Adhesion to Rigid Substrate.
- D. Compressed Gas Association (CGA):
1. Standard G-4.1 - Cleaning Equipment for Oxygen Service.
- E. NSF International (NSF):
1. Standard 61 - Drinking Water System Components - Health Effects.
- F. United States Code of Federal Regulations (CFR):
1. 21 - Food and Drugs.

1.03 SYSTEM DESCRIPTION

- A. Design requirements:
1. General purpose AWWA butterfly valves:
 - a. Design standard: Provide valves designed and manufactured in accordance with AWWA C504.
 - b. Class:
 - 1) Provide butterfly valves in accordance with AWWA Class 150B, unless otherwise specified.
 - 2) Provide butterfly valves in accordance with AWWA Class 250B in piping systems with test pressure greater than 150 pounds per square inch and less than 250 pounds per square inch.
- B. Usage:
1. Provide and install butterfly valve types as outlined in the Butterfly Valve Application Schedule at the end of this Section.
- C. Design requirements for all butterfly valves with power actuating devices:
1. Design valves and actuators for maximum operating torque, in accordance with and using safety factors required in AWWA C540, using the following values:
 - a. Maximum water velocity: 16 feet per second with valve fully open.
 - b. Maximum pressure differential across the closed valve equal to the pressure class designation.
 - c. Coefficient for seating and unseating torque, dynamic torque, and bearing friction in accordance with valve manufacturer's published recommendations.
 2. Valve disc: Seat in an angular position of 90 degrees to the pipe axis and rotate an angle of 90 degrees between fully open and fully closed positions:
 - a. Do not supply valves with stops or lugs cast with or mechanically secured to the body of the valve for limiting the disc travel.

3. Unacceptable thrust bearings: Do not provide valves with thrust bearings exposed to the fluid in the line and consisting of a metal bearing surface in rubbing contact with an opposing metal bearing surface.
- D. Performance requirements:
1. Tight shutoff at the pressure rating of the valve with pressure applied in either direction.
 2. Suitable for the following service conditions:
 - a. Throttling.
 - b. Frequent operation.
 - c. Operation after long periods of inactivity.
 - d. Installation in any position and flow in either direction.

1.04 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data: As specified in Section 40_05_51.01 - Common Work Results for Valves:
1. For general purpose AWWA butterfly valves:
 - a. Include description of the method of attachment of the disc edge to the valve disc.
 - b. Provide affidavit of compliance stating that the valve furnished fully complies with AWWA C504.
 2. Interior epoxy coatings: Affidavit of compliance attesting that epoxy coatings applied to interior surfaces of butterfly valves comply with all provisions in accordance with AWWA C550.
 3. Certification, for valves and coatings in contact with potable water, that the products used are suitable for contact with drinking water in accordance with NSF Standard 61.
- C. Commissioning submittals:
1. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01_75_17 - Commissioning.

1.05 WARRANTY

- A. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL PURPOSE AWWA BUTTERFLY VALVES

- A. Manufacturers: One of the following or equal:
1. Mueller Co., LLC.
 2. Kennedy Valve Co.
 3. DeZURIK/Sartell Model BAW.
 4. Henry Pratt Co.
- B. Valve body:
1. Material: Cast iron, ASTM A126, Grade B, or ductile iron, ASTM A536, Grade 65-45-12.

2. Body design:
 - a. Flanged body valves:
 - 1) Usage: Comply with limitations specified in the Butterfly Valve Application Schedule.
 - 2) Flanges: In accordance with ASME B16.1 Class 125 flanges for Class 150B valves, in accordance with ASME B16.1 Class 250 flanges for Class 250B valves.
 - b. Mechanical joint body valves:
 - 1) Usage: Comply with limitations specified in the Butterfly Valve Application Schedule.
 - 2) Mechanical joint design: In accordance with AWWA C110.
 - 3) When mechanical joint body valves are used, incorporate valve into thrust restraint analysis as specified in Section 33_05_19.01 - Ductile Iron Pipe: AWWA C151. Utilize test pressure on one side of valve and zero pressure on the opposite side of the valve. Restrain pipe joints on both sides of valve as determined by thrust analysis calculations.
- C. Disc:
 1. Material: Cast iron or ductile iron with Type 316 stainless steel edge that matches seat in valve body.
 2. Secure valve disc to shaft by means of smooth-sided, taper or dowel pins, Type 316 stainless steel, or Monel.
 3. Extend pins through shaft and mechanically secure in place.
- D. Shaft and bearings:
 1. Shaft design:
 - a. Valves 20-inches and less: 1-piece, through disc design.
 - b. Valves greater than 20-inch size: 2-piece, stub shaft design.
 2. Shaft seal: Vee type, chevron design.
 3. Shaft material for Class 150B valves: Type 316 stainless steel, ASTM A276.
 4. Shaft material for Class 250B valves: Type 17-4 pH stainless steel, ASTM A564.
 5. Shaft bearings: Self-lubricating sleeve type:
 - a. Valves 20 inches and less: Nylatron.
 - b. Valves greater than 20-inch size: Teflon™ with stainless steel or fiberglass backing.
- E. Seats:
 1. Seat materials:
 - a. In all other applications: EPDM.
 2. For valves 20 inches in nominal size and smaller, bond or vulcanize seat into the valve body.
 3. For valves 24 inches in nominal size and larger, retain seats mechanically or by adhesive:
 - a. Mechanical retainage: Retain seat by a clamping ring with segmented clamping ring locks with adjusting locking screws:
 - 1) Clamping ring, ring locks, and adjusting locking screws: Type 316 stainless steel.
 - 2) Provide means to prevent ring locks and screws used to retain seats from loosening due to vibration or cavitation.

- b. Adhesive retainage: Inset the seat within a groove in the valve body and retain in place with epoxy injected behind the seat so that the seat expands into the body.
 - c. Do not provide valves with seats retained by snap rings or spring-loaded retainer rings.
4. Resilient seat: Withstand 75 pound per inch pull when tested in accordance with ASTM D429, Method B.

F. Valve packing:

1. Valves 4 inches to 48 inches nominal size: Self-adjusting V-type packing or chevron-type packing. EPDM to match seat material.

2.02 COATING

A. Shop coat interior and exterior metal surfaces of valves, except as follows:

1. Interior machined surfaces.
2. Surfaces of gaskets and elastomeric seats and stem seals.
3. Bearing surfaces.
4. Stainless steel surfaces and components.

B. Coating material for potable water applications:

1. Formulate interior coating material from materials in accordance with CFR 21, AWWA C550, and NSF 61.
2. Submit affidavit of compliance attesting that epoxy coatings applied to interior surfaces of butterfly valves in accordance with CFR 21, AWWA C550, and NSF 61.

C. Interior surfaces:

1. Interior surfaces, except for valves used in low-pressure air service: High solids epoxy.
2. Interior surfaces of valves used in low-pressure air service: High temperature coating for range of 150 to 350 degrees Fahrenheit.

D. Exterior surfaces:

1. Exterior surfaces of valves, actuators, and accessories coating in accordance with Section 09_96_01 - High-Performance Coatings with the following coating types:
 - a. Buried valves: Coal tar epoxy.
 - b. Other valves: High solids epoxy with polyurethane topcoat.
2. Polished and machined surfaces: Apply rust-preventive compound:
 - a. Manufacturers: One of the following or equal:
 - 1) Houghton, Rust Veto 344.
 - 2) Rust-Oleum, R-9.

E. Coating materials:

1. High solids epoxy and coal tar epoxy:
 - a. Products: As specified in Section 09_96_01 - High-Performance Coatings:
 - 1) Coating product in contact with potable water must be in accordance with AWWA C550 and NSF 61.
2. High temperature coating: As specified in Section 09_96_01 - High-Performance Coatings and in accordance with AWWA C550.

3. Rust-preventive compound:
 - a. Manufacturers: One of the following or equal:
 - 1) Houghton, Rust Veto 344.
 - 2) Rust-Oleum, R-9.
- F. Field applied coatings of valve exterior:
 1. Match color and be compatible with manufacturer's coating system and as specified in Section 09_96_01 - High-Performance Coatings:
 - a. When shop applied finish coating matches field applied coating on adjacent piping, touch up shop coating in damaged areas in accordance with instructions recommended by the paint manufacturer.
 - b. When shop applied coating does not match field coating on adjacent piping, or when damage has occurred to the shop applied coating that requires more than touchup, blast clean valve surfaces or utilize other surface preparation recommended by the manufacturer of the coating material and apply the coating system used for coating adjacent piping.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install valves with valve shafts horizontal, unless a vertical shaft is required to suit a particular installation, and unless a vertical shaft is indicated on the Drawings.
- B. Install pipe spools or valve spacers in locations where butterfly valve disc travel may be impaired by adjacent pipe lining, pipe fittings, valves, or other equipment.

3.02 COMMISSIONING

- A. As specified in Section 01_75_17 - Commissioning and this Section.
- B. Manufacturer services:
 1. Provide certificates:
 - a. Manufacturer's Certificate of Installation and Functionality Compliance.
- C. Functional testing:
 1. Valves:
 - a. Test witnessing: Witnessed.
 - b. Conduct pressure and leak test, as specified in Section 40_05_51.01 - Common Work Results for Valves.

END OF SECTION

SECTION 40_05_65.01

GATE, GLOBE, AND ANGLE VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Gate, globe, angle, plug disc and plain hose valves, and yard hydrants.
- B. As specified in Section 40_05_51.01 - Common Work Results for Valves.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 inch Standard.
 - 2. B16.47 - Large Diameter Steel Flanges: NPS 26 through NPS 60 inch Standard.
 - 3. B36 - Stainless Steel Pipe.
- B. American Water Works Association (AWWA):
 - 1. C515 - Standard for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Services.
 - 2. C 550 - Protective Interior Coatings for Valves and Hydrants.
- C. ASTM International (ASTM):
 - 1. B98 - Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.

1.03 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data: As specified in Section 40_05_51.01 - Common Work Results for Valves.
- C. Commissioning submittals: For valves larger than 16 inches:
 - 1. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01_75_17 - Commissioning.

1.04 WARRANTY

- A. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds.
- B. Interior epoxy coatings: Affidavit of compliance attesting that epoxy coatings applied to interior surfaces of valves comply in accordance with all provisions of AWWA C550.

PART 2 PRODUCTS

2.01 GATE VALVES

- A. Gate valves 3 inches to 16 inches:
 - 1. Manufacturers: No exceptions:
 - a. Mueller Co., LLC.
 - b. Kennedy Valve Co.
 - 2. Design:
 - a. Size and configuration: Indicated on the Drawings.
 - b. Gate valves shall be ductile iron (DI) body, bronze-mounted, double-disc, resilient seat, non-rising stem valves with o-ring seals and shall open when the stem is rotated counterclockwise. Valves shall have two (2) inch square wrench nuts. Joint materials shall conform to AWWA C110.
 - c. Valves shall conform to AWWA C-515 and AWWA C-509.

2.02 GLOBE AND ANGLE VALVES (NOT USED)

2.03 HOSE VALVES AND YARD HYDRANTS (NOT USED)

PART 3 EXECUTION

3.01 FIELD APPLIED COATING OF VALVE EXTERIOR

- A. Match color and be compatible with manufacturer's coating system and as specified in Section 09_96_01 - High-Performance Coatings:
 - 1. When shop applied finish coating matches field applied coating on adjacent piping, touch up shop coating in damaged areas in accordance with instructions recommended by the paint manufacturer.
 - 2. When shop applied coating does not match field coating on adjacent piping, or when damage has occurred to the shop applied coating that requires more than touchup, blast clean valve surfaces or utilize other surface preparation recommended by the manufacturer of the coating material and apply the coating system used for coating adjacent piping.

3.02 COMMISSIONING

- A. As specified in Section 01_75_17 - Commissioning and this Section.
- B. Manufacturer services: For valves larger than 16-inches:
 - 1. Provide certificates:
 - a. Manufacturer's Certificate of Installation and Functionality Compliance.
- C. Functional testing:
 - 1. Valves:
 - a. Test witnessing: Witnessed.
 - b. Conduct pressure and leak test as specified in Section 40_05_51.01 - Common Work Results for Valves.

END OF SECTION

SECTION 40_05_65.24

CHECK VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Check valves.
- B. As specified in Section 40_05_51.01 - Common Work Results for Valves.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Inch Standard.
- B. American Water Works Association (AWWA):
 - 1. C508 - Standard for Swing-Check Valves for Waterworks Service 2 Inch Through 24 Inch NPS.
- C. ASTM International (ASTM):
 - 1. A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. A313 - Standard Specification for Stainless Steel Spring Wire.
 - 3. A536 - Standard Specification for Ductile Iron Castings.
 - 4. B582 - Standard Specification for Nickel-Chromium-Iron-Molybdenum-Copper Alloy Plate, Sheet, and Strip.
 - 5. B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

1.03 SYSTEM DESCRIPTION

- A. Design requirements:
 - 1. Check valves: When not otherwise specified as indicated on the Drawings, provide check valves suitable for service as follows:
 - a. In either horizontal or vertical position.
 - b. Suitable for service working pressures up to 150 pounds per square inch gauge.

1.04 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data: As specified in Section 40_05_51.01 - Common Work Results for Valves.

- C. Commissioning submittals:
 - 1. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01_75_17 - Commissioning.

1.05 WARRANTY

- A. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 PLASTIC BALL CHECK VALVES

- A. Manufacturers: One of the following or equal:
 - 1. Chemtrol Division of Nibco.
 - 2. Georg Fischer Piping Systems.
 - 3. Plast-O-Matic Valves, Inc.
 - 4. Hayward Flow Control.
- B. Valves: Ball type:
 - 1. Material: Polyvinyl chloride.
 - 2. End connection: Double-or single-union-type.
 - 3. Seals: Viton™.
- C. Valve body material:
 - 1. Polyvinyl chloride (PVC).
- D. Union connections material:
 - 1. Socket ends conforming to ASME B16.5 pipe flanges and flange fittings, Class 150.
- E. Seats and seals material:
 - 1. Viton™.
- F. Maximum inlet pressure rating:
 - 1. PVC: 150 pound per square inch at 77 degrees Fahrenheit.

2.02 DUCKBILL CHECK VALVES

- A. Manufacturers: One of the following or equal:
 - 1. Tide Flex, Series TF-2.
- B. Design:
 - 1. Maximum downstream head: 30 feet.
 - 2. With internal pressure 1 to 2 inches w.c. above backpressure, bill of valve opens, allowing flow.
 - 3. With backpressure 1 to 2 inches w.c. above internal pressure, bill of valve closes, preventing backflow.
- C. End connection:
 - 1. Slip-on with Type 316 stainless steel clamp.

- D. Materials of construction:
 - 1. Single piece elastomer construction with internal polyester fabric reinforcing all vulcanized into a composite material:
 - a. Internal reinforcing sufficient to maintain structural integrity under the specified operating conditions.
 - b. Exterior applications require coating for UV protection and to resist pest gnawing.
 - 2. Elastomeric material: Viton.

PART 3 EXECUTION

3.01 FIELD APPLIED COATING OF VALVE EXTERIOR

- A. Match color and be compatible with manufacturer's coating system and as specified in Section 09_96_01 - High-Performance Coatings:
 - 1. When shop applied finish coating matches field applied coating on adjacent piping, touch up shop coating in damaged areas in accordance with instructions recommended by the paint manufacturer.
 - 2. When shop applied coating does not match field coating on adjacent piping, or when damage has occurred to the shop applied coating that requires more than touchup, blast clean valve surfaces or utilize other surface preparation recommended by the manufacturer of the coating material and apply the coating system used for coating adjacent piping.

3.02 COMMISSIONING

- A. As specified in Section 01_75_17 - Commissioning and this Section.
- B. Manufacturer services:
 - 1. Provide certificates:
 - a. Manufacturer's Certificate of Installation and Functionality Compliance.
- C. Functional testing:
 - 1. Valves:
 - a. Test witnessing: Witnessed.
 - b. Conduct pressure and leak test, as specified in Section 40_05_00.09 - Piping Systems Testing.

END OF SECTION

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SECTION 40_05_67.37

PRESSURE REDUCING AND PRESSURE RELIEF VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Pressure reducing and pressure relief valves for water, air, sludge and chemical service.
- B. As specified in Section 40_05_51.01 - Common Work Results for Valves.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
- B. ASTM International (ASTM):
 - 1. A48 - Standard Specification for Gray Iron Castings.
 - 2. A536 - Standard Specification for Ductile Iron Castings.
- C. Underwriters Laboratories, Inc. (UL).

1.03 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data: As specified in Section 40_05_51.01 - Common Work Results for Valves.
- C. Commissioning submittals:
 - 1. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01_75_17 - Commissioning.

1.04 WARRANTY

- A. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 WATER PRESSURE REDUCING VALVES

- A. Water pressure reducing valves, 3 inches and larger:
 - 1. Manufacturers: One of the following, or equal:
 - a. Cla-Val Model 100-01.
 - b. Watts ACV Series 115.
 - 2. Design:
 - a. Pilot controlled, hydraulically operated, diaphragm actuated, globe patterned valve.

- b. Solenoid controls as indicated in the Drawings:
 - 1) Body: Brass ASTM B283.
 - 2) Enclosure: NEMA 4X.
 - 3) Voltage as indicated in the Drawings.
 - 4) Coil: Insulation Class F.
- c. Rated for 125 pounds per square inch gauge.
- d. Pilot line: Equipped with a strainer.
- e. Flanges: 150 pound rating, in accordance with ASME B16.42.
- 3. Materials:
 - a. Body and cover: Cast iron ASTM A48 or Ductile Iron ASTM A536.
 - b. Valve trim: Bronze.
 - c. Pilot control: Cast bronze with Series 303 stainless steel trim.
 - d. Diaphragm: Nylon reinforced Buna N.

2.02 WATER PRESSURE RELIEF VALVES (NOT USED)

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install as specified in Section 40_05_51.01 - Common Work Results for Valves.

3.02 FIELD APPLIED COATING OF VALVE EXTERIOR

- A. Match color and be compatible with manufacturer's coating system and as specified in Section 09_96_01 - High-Performance Coatings:
 - 1. When shop applied finish coating matches field applied coating on adjacent piping, touch up shop coating in damaged areas in accordance with instructions recommended by the paint manufacturer.
 - 2. When shop applied coating does not match field coating on adjacent piping, or when damage has occurred to the shop applied coating that requires more than touchup, blast clean valve surfaces or utilize other surface preparation recommended by the manufacturer of the coating material and apply the coating system used for coating adjacent piping.

3.03 COMMISSIONING

- A. As specified in Section 01_75_17 - Commissioning and this Section.
- B. Manufacturer services:
 - 1. Provide certificates:
 - a. Manufacturer's Certificate of Installation and Functionality Compliance.
- C. Functional testing:
 - 1. Valves:
 - a. Test witnessing: Witnessed.
 - b. Conduct pressure and leak test as specified in Section 40_05_51.01 - Common Work Results for Valves.

END OF SECTION

SECTION 40_05_67.40

AIR AND VACUUM RELIEF VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Chemical degas valves.
- B. As specified in Section 40_05_51.01 - Common Work Results for Valves.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.
- B. American Water Works Association (AWWA).
- C. ASTM International (ASTM):
 - 1. A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 3. A270 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Sanitary Tubing.
 - 4. B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

1.03 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data: As specified in Section 40_05_51.01 - Common Work Results for Valves.
- C. Commissioning submittals:
 - 1. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01_75_17 - Commissioning.

1.04 WARRANTY

- A. Provide warranty as specified in Section 01_78_36 - Warranties and Bond.

PART 2 PRODUCTS

2.01 COMBINATION AIR VALVES, WATER SERVICE

- A. Manufacturers: One of the following or equal:
 - 1. Val-Matic Valve and Manufacturing Corp, Series 201C.2.
- B. Design:
 - 1. Operation: Automatic exhaust of large quantities of air from pipelines during filling and draining and release of accumulated air while pipeline is under pressure.
 - 2. Utilize compound lever system in conjunction with large and small orifices.
 - 3. Internal parts removable through top cover without removing valve from pipeline.
 - 4. Pressure rating: Designed for a working pressure not less than 150 pounds per square inch and tested at a pressure not less than 300 pounds per square inch. A test certification shall be provided if requested by the Engineer.
 - 5. Inlet and Outlet: Screwed, 1-inch size.
- C. Materials:
 - 1. Body: Cast iron, ASTM A48.
 - 2. Float: Type 316 stainless steel, ASTM A240.
 - 3. Needle: Buna-N.
- D. Refer to City Standard Detail W-25 for additional requirements.

2.02 DEGASSING VALVE FOR SODIUM HYPOCHLORITE SERVICE

- A. Manufacturers: One of the following or equal:
 - 1. Plast-O-Matic, DGV.
 - 2. Primary Fluid Systems.
- B. Materials:
 - 1. Body: PVC.
 - 2. Elastomers: FKM (Viton™).
 - 3. Rating: 100 pounds per square gauge.
 - 4. Connection: 1/4 inch NPT minimum.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install as specified in Section 40_05_51.01 - Common Work Results for Valves and manufacturer's instructions.
- B. Install degas valves with suitable discharge lines to nearest drainage system.

3.02 COMMISSIONING

- A. As specified in Section 01_75_17 - Commissioning and this Section.

- B. Manufacturer services:
 - 1. Provide certificates:
 - a. Manufacturer's Certificate of Installation and Functionality Compliance.

- C. Functional testing:
 - 1. Valves:
 - a. Test witnessing: Witnessed.
 - b. Conduct pressure and leak test as specified in Section 40_05_51.01 - Common Work Results for Valves.

END OF SECTION

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SECTION 40_61_15
CONTROL STRATEGIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Common control functions:
 - a. General control and monitoring functions to be provided throughout the PCS system:
 - 1) These requirements apply to all systems, and information indicated on the Drawings.

1.02 REFERENCES

- A. As specified in Section 40_90_00 - Instrumentation and Controls.

1.03 DEFINITIONS

- A. As specified in Section 40_90_00 - Instrumentation and Controls.

1.04 SYSTEM DESCRIPTION (NOT USED)

1.05 SUBMITTALS

- A. As specified in Section 40_90_00 - Instrumentation and Controls and the General Terms and Conditions.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

- A. As specified in Section 40_90_00 - Instrumentation and Controls and the General Terms and Conditions.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION (NOT USED)

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION

- A. As specified in Section 40_90_00 - Instrumentation and Controls.
- B. Common control functions:
 - 1. Incorporate common control functions into all control loops and devices and into the control programming, whether or not specifically shown in the specific control descriptions or elsewhere in the Contract Documents.
 - 2. Tank levels:
 - a. Display all tank levels as both a level (typically in feet) and a volume (typically in gallons):
 - 1) Some individual displays may be only level or volume, when agreed to by the Owner and Engineer during screen review meetings.
 - b. Monitor rate of change of volume on all tanks and vessels:
 - 1) Establish the maximum withdraw rate at which the volume should decrease (all pumps or feeders operating at maximum output). Generate an alarm whenever the volume decreases faster than this rate:
 - a) Activation of the maximum withdraw rate alarm from chemical storage tanks shall automatically close the associated discharge valve:
 - (1) If all tank discharge valves are closed, the chemical metering pump system will be shut down.
 - 2) Establish the maximum fill rate at which the volume should increase when filling. Generate an alarm whenever the volume increases faster than this rate. Verify tank and vessel level is fluctuating to verify the validity of the IO register. If it is determined the register is not active or failed in a manner that leaves a stagnant value generate an alarm.
 - 3. Valve control:
 - a. Monitor the device's LOCAL-STOP-REMOTE (LSR) switch(es) (the integral switch in the actuator or hard-wired switch at the local control station):
 - 1) Display current REMOTE status on PCS screens.

- b. Start an "Open Activation" timer whenever the device is expected to be open (PLC has issued an OPEN command in PCS AUTO, or OPEN was selected in PCS HAND):
 - 1) Initially set "Open Activation" time to twice the normal opening time.
 - 2) If the LSR position and open command do not change, and the PLC does not receive fully open status feedback within the "Open Activation" time period:
 - a) De-activate the open output.
 - b) Place the device in a "Failed" state.
 - c) Generate a "Failed to Open" alarm.
 - c. Start a "Close Activation" timer whenever the device is expected to be closed (PLC has issued a CLOSE command in PCS AUTO, or CLOSE was selected in PCS HAND):
 - 1) Initially set "Close Activation" time to twice the normal closing time.
 - 2) If the LSR position and close command do not change, and the PLC does not receive fully closed status feedback within the "Close Activation" time period:
 - a) De-activate the close output.
 - b) Place the device in a "Failed" state.
 - c) Generate a "Failed to Close" alarm.
 - d. Limit the number of open/close /commands so that it does not exceed the manufacturer requirements.
 - e. Provide separate time delay settings for each function and for each device.
 - f. If the valve position inputs indicate an invalid state (i.e., valve open and closed at the same time), place the device in a "Failed" state and generate an "Invalid State" alarm.
 - g. Re-establish PLC control of a device in a "Failed" state only after one of the following:
 - 1) An operator turns the device's LSR switch out of REMOTE and back to REMOTE (i.e., REMOTE input to the PLC cycles off and back on).
 - 2) An operator acknowledges the fault from PCS.
 - h. For all alarm conditions, control other devices (as stopping pumps, etc.) as stated in the individual loop descriptions to make the system safe.
 - i. For discrete modulating valves (valves positioned to intermediate positions to control process values through discrete OPEN and CLOSE outputs), count the number of actuations (OPEN or CLOSE commands) per hour in the PLC:
 - 1) Display count on the HMI.
4. Chemical systems (LOI/HMI):
- a. Provide the following chemical system screens:
 - 1) Where one LOI manages more than one chemical system, a main menu screen that will allow the operator to access the individual chemical system screens using software keys.
 - 2) One or more screens for each individual chemical system controlled at that location, containing:
 - a) All status displays (running, failed, etc.).
 - b) Selections (lead/lag, which process flow to pace to, etc.).
 - c) Setpoint entry and display.
 - d) Calculated feed requirement (result of flow pacing calculation) in engineering units (typically milligrams of chemical per minute).

- e) Output signal to feeder in percent of full span.
- f) Actual chemical flow rate from flowmeter (where shown).
- g) Process flow rate(s) used to pace each chemical on the individual chemical screens (PROC FLOW):
 - (1) Where different process flows can be selected for flow pacing, display and identify the selected source.
- b. Chemical system calculations: Perform calculations as indicated on the Drawings and in the individual loop descriptions. Use the following assumptions, unless otherwise noted:
 - 1) Where chemical flow feedback is not used, assume feeder output is linear in response to control signal.
 - 2) Zero signal (typically 4 milliamperes) produces zero flow.
 - 3) Perform flow-pacing calculations using as indicated on the Drawings or described in the individual loop descriptions.
- c. Provide the setpoints and selections indicated on the Drawings and in the individual loop descriptions. Typical setpoints include:
 - 1) QMAX: Maximum calibration value:
 - a) Chemical flow rate measured from calibration column at maximum feeder output (typically in gallons of solution per hour or milliliters of solution per minute).
 - 2) CONC: Chemical concentration:
 - a) The concentration of the chemical in the solution to be fed, in engineering units (typically milligrams of chemical per liter of chemical solution).
 - 3) DENSITY:
 - a) Density of the chemical solution to be fed in engineering units or as a specific gravity.
 - b) Used to calculate the concentration of the chemical in the solution.
 - 4) DOSE: Desired dosage:
 - a) Desired chemical concentration in the process stream in engineering units (typically milligrams of chemical per liter of process fluid).
 - 5) FLOW SEL: Selection of process stream(s) for flow pacing.
 - 6) OPEN/CLOSED LOOP:
 - a) Selection of method of controlling chemical flow-paced feed rate.
 - b) OPEN LOOP: Signal to feeder is based on feeder calibration (QMAX) to deliver calculated chemical solution feed rate. Chemical solution flowmeter is not used for control.
 - c) CLOSED LOOP: Chemical feed rate is directly controlled using the calculated chemical solution feed rate as the setpoint, and the flow rate from the chemical solution flowmeter as the process variable.
- d. Chemical control algorithms:
 - 1) Feed forward chemical dose algorithm: Operator selects a desired chemical concentration in the process flow and the control systems determines the required chemical dose based on the measured

chemical concentration. The calculation is as follows (units may vary from those shown in the calculation below):

$$D_c = C_s - C_m$$

Where,

D_c = Calculated dose setpoint (mg/L)

C_s = Desired process flow chemical concentration (mg/L) User Adjustable

C_m = Measured process flow chemical concentration from upstream analyzer (mg/L)

If $D_c < 0$, value will be set to 0

- 2) Flow pacing algorithm: Operator selects a desired dose or the control system sets the dose setpoint from the feed forward chemical dose calculation and the control system adjusts the chemical feed rate to dose based on process flow, chemical concentration, and feeder calibration. The calculation is as follows (units may vary from those shown in the calculation below):

$$Q_c = \frac{D_c \cdot Q_f \cdot 8.34}{24 \cdot C \cdot p}$$

Where,

Q_c = Chemical Pump flow Rate command (gal/hr)

Q_f = Process Flow (MGD) Measurement

D_c = Dose setpoint from feed forward chemical dose algorithm (mg/L), can be overridden with Operator selected value

p = Chemical Density (lbs/gal)

C = Chemical Concentration (ratio)

8.34 = conversion factor ([lbs • L]/[MG • day • mg])

24 = conversion factor days to hours

$$S = \frac{Q_c}{Q_{max}}$$

Where,

S = Pump Speed control setpoint (0 to 100%)

Q_c = Flow setpoint from equation above (gal/hr)

Q_{max} = Maximum Pump Flow setpoint (gal/hr) based on calibration column test.

- 3) Batch process algorithm: Operator selects a desired tank chemical concentration and if the measured concentration is less than the desired setpoint, the control system feeds chemical at an Operator set flowrate for a setpoint duration. After a set delay to allow for tank mixing, the tank chemical concentration is measured and the process repeats until the desired tank chemical concentration is achieved.
- e. Virtual day tanks:
- 1) Chemical systems without actual day tanks will have their own "virtual" day tank, which will calculate the daily use rate based on the totalized flow (volume) of the chemical metering pump flow output over the virtual day tank cycle.

- 2) As an added level of control any chemical system that has an analyzer used for feedback will be tracked and alarmed if outside the operating parameters.
- 3) Alarm if any condition falls outside of the flow, or level parameters.
- 4) The daily volumes will be summed to provide the total monthly chemical usage, resetting on the first day of a new month. The daily and monthly volumes shall be logged in the historian.

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL (NOT USED)

3.08 ADJUSTING (NOT USED)

3.09 CLEANING (NOT USED)

3.10 DEMONSTRATION AND TRAINING

A. As specified in Section 40_90_00 - Instrumentation and Controls.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 40_75_23

ANALYZERS: RESIDUAL CHLORINE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Residual chlorine analyzers.
- B. Provide all instruments identified in the Contract Documents.

1.02 REFERENCES

- A. As specified in Section 40_90_00 - Instrumentation and Controls.

1.03 DEFINITIONS

- A. As specified in Section 40_90_00 - Instrumentation and Controls.

1.04 SUBMITTALS

- A. Furnish submittals as specified in the General Terms and Conditions and Section 40_90_00 - Instrumentation and Controls.
- B. Provide complete documentation covering the traceability of all calibration instruments.

1.05 QUALITY ASSURANCE

- A. As specified in Section 40_90_00 - Instrumentation and Controls.
- B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:
 - 1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.
 - 2. Physical conditions:
 - a. Installation and mounting requirements.
 - b. Location within the process.
 - c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.
- C. Notify the Engineer if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 40_90_00 - Instrumentation and Controls.

1.07 PROJECT OR SITE CONDITIONS

- A. Project environmental conditions as specified in Section 40_90_00 - Instrumentation and Controls:
 - 1. Provide instruments suitable for the installed site conditions including, but not limited to, material compatibility, site altitude, site seismic conditions, humidity, and process and ambient temperatures.

1.08 WARRANTY

- A. As specified in Section 40_90_00 - Instrumentation and Controls and the General Terms and Conditions.

1.09 MAINTENANCE

- A. Furnish all parts, materials, fluids, etc. necessary for operation, maintenance, and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Amperometric residual analyzers:
 - 1. Emerson, Rosemount Analytical:
 - a. Complete Panel FCL Free Chlorine Measuring System Order number FCL-02-241 – Includes panel, 499ACL-01-54-VP free chlorine sensor, 3900VP-02-10 pH sensor, 56-03-24-32-HT transmitter, flow assembly, and cables.

2.02 MANUFACTURED UNITS

- A. Amperometric residual analyzers:
 - 1. General:
 - a. Residual chlorine analyzer utilizing amperometric technology for continuous monitoring of the free chlorine residual in solution.
 - 2. Performance requirements:
 - a. Continuous on-line analysis for free or total chlorine residual.
 - b. Minimum detection: 0.040 milligrams per liters.
 - c. Accuracy:
 - 1) Within 5 percent of reading or within 0.035 milligrams per liters.
 - d. Range:
 - 1) 0 to 5 milligrams per liters free or total residual.
 - e. Repeatability:
 - 1) Within 5 percent or 0.05 milligrams per liters.
 - 3. Components:
 - a. Flow through sensors, including flow rate control, multiple probes.
 - b. Panel board with instruments mounted.
 - 4. Transmitter:
 - a. Power supply:
 - 1) 120 VAC.
 - 2) Power consumption: 95 VA maximum.

- b. Outputs:
 - 1) 4 to 20 milliamperes isolated output with span programmable over any portion of the chlorine residual range.
 - 2) 4 to 20 milliamperes isolated output with span programmable over any portion of the range of pH.
 - 3) As indicated on the instrument datasheets.
 - 4) Relay outputs:
 - a) SPST relay contacts: 2.
 - b) Selectable to activate on the following conditions:
 - (1) High or low sample concentration.
 - (2) Analyzer system warning.
 - (3) Analyzer system shutdown.
 - 5) Components:
 - a) Manufacturer's cables.
- c. Microprocessor-based signal converter/transmitter.
- d. Display:
 - 1) LCD, 2-line minimum.
- e. Enclosure:
 - 1) NEMA Type 4X.

2.03 SOURCE QUALITY CONTROL

- A. As specified in Section 40_90_00 - Instrumentation and Controls.
- B. Factory calibrate each instrument with a minimum 3-point calibration or according to Manufacturer's standard at a facility that is traceable to the NIST:
 - 1. Submit calibration data sheets to the Engineer at least 30 days before shipment of the instruments to the project site.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine the installation location for the instrument and verify that the instrument will work properly when installed:
 - 1. Notify the Engineer promptly if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

- A. As specified in Section 40_90_00 - Instrumentation and Controls.

3.04 FIELD QUALITY CONTROL

- A. As specified in Section 40_90_00 - Instrumentation and Controls.
- B. Provide manufacturer's services to perform installation inspection, start-up and calibration/verification.

3.05 ADJUSTING

A. As specified in Section 40_90_00 - Instrumentation and Controls.

3.06 CLEANING

A. As specified in Section 40_90_00 - Instrumentation and Controls.

3.07 DEMONSTRATION AND TRAINING

A. As specified in Section 40_90_00 - Instrumentation and Controls.

3.08 PROTECTION

A. As specified in Section 40_90_00 - Instrumentation and Controls.

3.09 SCHEDULES

A. Instruments may be indicated on the Drawings, specified in the Specifications, or both.

END OF SECTION

A/E: Carollo Engineers				CHLORINE RESIDUAL ANALYZERS					
Contractor:								Spec. No.	
Project:								40_75_23	
Customer: City of Mercer Island								Contract	
Plant:								Date	
Location:								Req.	
BOM No.:								P.O.	
File:								By	
								Chk	
								App	
G E N	1	Tag No.	Sample Unit	Transmitter	AE/AIT-				
	2	Service			Residual Chlorine				
	3	P&ID							
S M P L U N I T	4	Type			Amperometric				
	5	Enclosure			NEMA 4X				
	6	Sampling Method			Slip Stream				
	7	Operating Temperature Range			35-120 degrees F				
	8	Sample Temperature Range			40-80 degrees F				
	9	Sample Flow Required							
	10	Manufacturer							
	11	Model No.							
C A B L E	12	Other							
	13	Style			N/A				
	14	Length							
	15	Model No.							
	16	Other							
T R A N S M I T T E R	17	Other							
	18	Type			Control Unit and Display				
	19	Enclosure			NEMA 12				
	20	Mounting							
	21	Accuracy							
	22	Range							
	23	Power Requirements			115 VAC, 60 HZ				
	24	Display			LCD				
	25	Resolution							
	26	Output			4-20 mA				
	27	Calibration							
	28	Manufacturer							
O P T S	29	Model No.							
	30	Other							
	31	Other							
	32	Other							
	33								
	34								
	35								
	36								
	37								
	38								
Notes:									

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SECTION 40_90_00

INSTRUMENTATION AND CONTROLS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. This spec section is intended to specify the components of the instrumentation and control system including control panel(s) and the general requirements for the construction and arrangement of the associated equipment and field instrumentation.
- B. Work and materials specified in this section include:
 - 1. PLC control cabinet(s) (RTU at SPU68), I/O, and associated equipment and instrumentation.
 - 2. Field Instrumentation, installation, and calibration requirements.
 - 3. Shop and field testing, and calibration of power & control system components and equipment.
 - 4. Startup, Testing and Training.

1.02 SYSTEM DESCRIPTION

- A. Reservoir Site - work includes the following:
 - 1. Interconnection/shop drawings for interface of all new equipment and instrumentation to the existing MCP per the P&IDs and wire diagrams for all control, monitoring and alarming.
 - 2. Cl₂ injection control valves.
 - 3. Reservoir and crossover control valves.
 - 4. Cl₂ & pH analyzers.
 - 5. Flow and pressure switches.
 - 6. Field instrumentation and control devices and installation details.
- B. SPU68 Site - work includes the following:
 - 1. RTU control panel in outdoor enclosure with PLC and OI for all control, monitoring and alarming of equipment and instrumentation.
 - 2. Cell modem/antenna for remote monitoring.
 - 3. Interconnection/shop drawings for the interface of all new equipment and instrumentation.
 - 4. Flow transmitter.
 - 5. Intrusion and flood switches.
 - 6. Field instrumentation and control devices and installation details.

1.03 SYSTEM INTEGRATOR

- A. The System Integrator shall be responsible for the final design and assembly of the instrumentation and control system and control panels.
- B. All programming of the existing PLC and operator interface in the MCP shall be done by Brown & Caldwell on a separate contract.

- C. The System Integrator shall be responsible for the final design and assembly of the entire I&C system at both sites. The system shall be designed to provide the control capabilities and functions indicated and implied by the plans and these specifications and to provide trouble-free operation with minimum maintenance. The system shall readily enable manual operation of any and all functions in the event of failure of any one component.
- D. Only pre-approved integrators shall provide equipment under this contract.
- E. The following are pre-approved System Integrators for this project:
 - 1. Quality Controls - Lynwood, Washington.
 - 2. Technical Systems, Inc. - Lynnwood, Washington.
 - 3. Taurus Controls, Kent, Washington.
 - 4. Systems Interface, Inc. - Bothell, Washington.
- F. Other alternate System Integrators may obtain pre-approval if they meet the following minimum requirements:
 - 1. Factory trained and certified for the controller, (PLC, telemetry equipment) provided on this project, or have a minimum of 3 years of field experience and at least four applicable projects with configuration and installation of this equipment. Integrator shall provide resumes for individuals performing the work showing successful completion of factory training and field experience.
 - 2. A minimum experience of 3 projects using cellular data modems for communications.
 - 3. Integrator shall provide UL 508A certification for control panels.
 - 4. Field service technicians shall have a minimum of 2 years of field experience with the components, controllers, and instruments provided on this project.
 - 5. Integrators shop shall be within 100 miles of the project site.

1.04 STANDARDS AND CODES

- A. All equipment and materials shall conform to the latest revised editions of applicable standards published by the following organizations:
 - 1. American National Standards Institute (ANSI).
 - 2. Institute of Electrical and Electronic Engineers (IEEE).
 - 3. National Electrical Manufacturer's Association (NEMA).
 - 4. Underwriters' Laboratories (U/L).
 - 5. Instrument Society of America (ISA).
- B. All electrical equipment and materials, and the design, construction, installation, and application thereof shall comply with all applicable provisions of the National Electrical Code (NEC), the Occupational Safety and Health Act (OSHA), and any applicable Federal, State, and local ordinances, rules, and regulations.
- C. All materials and equipment specified herein shall within the scope of UL examination services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- D. All control panels shall bear a label by UL or by an approved testing authority for the completed assembled panel.

1.05 SHOP DRAWINGS

- A. The System Integrator shall develop any shop drawings required for design, fabrication, assembly and installation of the power and control panels. Shop drawings shall include all drawings required in manufacture of specialized components and for assembly and installation of them. Shop drawings shall include detailed “end-to-end” control wiring diagrams showing all interface of field equipment and instrumentation. In addition, the following drawings shall be provided.
- B. Control Cabinet Layout Drawings:
1. The System Integrator shall develop shop drawings for the control cabinets and wiring and terminals within the control cabinets to show all details of the control system. Drawings shall include scaled drawings of both interior and exterior elevation views. All components shall be identified by both the nameplate information and also the component number related to the bill of materials.
- C. Equipment and Instrument Wiring Diagrams:
1. The System Integrator shall provide individual wiring diagrams (one drawing) for each field instrument and for each controlled motor load. All wiring interface for each instrument or equipment shall be shown on a single drawing* and the drawing shall be titled with the equipment or instrument name and number. Each drawing shall include field devices, PLC I/O and motor control, etc. associated with that instrument or equipment. Include all terminals – terminal numbers, wire numbers (both internal and field), PLC I/O and memory address, and equipment TAG number. See example drawings.
** for instruments of the same type - if space allows then more than one instrument of the same exact type may be shown on a single drawing. This exception applies for instruments only, not for equipment.*
- D. Card Drawings:
1. System Integrator shall provide the information for each input and each output of the PLC on “PLC Card drawings”. All details of each card must be shown on a single drawing – one I/O card per drawing*. Example drawings are included at the end of this section. Each I/O point shall be designated with the memory address, point id tag number, point description and wiring diagram reference drawing number.
** cards of the same type – if space allows, then more than one card of the same exact type may be shown on a single drawing.*
- E. Terminal Arrangement Drawings:
1. Provide terminal layout drawings that show the layout of all terminals in the cabinet.
- F. Shop drawings shall be drawn in AutoCAD current version and include the following:
1. Technical data sheets for all components with the complete part number of the component clearly designated with all required options.
 2. Arrangement drawings of all cabinet front-mounted and internal-mounted instruments, switches, devices, and equipment indicated. Show all panel mounting details required. Include outer dimensions of all panels on the

- drawing. Deviations from approved arrangements require resubmittal and approval prior to installation.
3. Arrangement drawings shall be drawn to scale using standard Architectural or Engineering scales.
 4. Shop drawings shall be provided on sheets no larger than 11-inches X 17-inches. Shop drawings shall include specific product detail such as rating, size, and number of contacts, etc. Wiring diagrams shall be included for all components in the system including control equipment supplied with mechanical devices.
 5. For shop drawing packages provide the drawings in a separate 11-inches X 17-inches binder with an index for the drawings at the front.
- G. Installation details shall include the size, number, type and location of interconnecting wiring and conduit, installation of cabinets and enclosures, installation of sensors, instruments, limit switches, and other installation requirements. Shop drawings shall be submitted to Engineer for review and approval.

1.06 SUBMITTALS

- A. Submittal Requirements:
1. Submittal documents shall be submitted via E-mail in PDF format.
 2. I&C submittals shall be provided in two complete separate documents one with all product data and a second with all shop drawings as follows:
 - a. All products shall be included in a single PDF document including the cover sheet and index and bill of materials (BOM) in one single document. Index the PDF document to show each individual product in the index column.
 - b. Shop drawings shall be included in a single PDF document including the cover sheet and index in one single document. (Note: delete all PDF comments).
 3. Submittals shall be indexed and identified as follows:
 - a. Email subject line shall be "**project name**, EI&C submittal **submittal #**, **spec section# - description**."
 - b. Cover sheet with:
 - 1) The project name and submittal #.
 - 2) Contractor's and sub-contractor's name, phone number, and email address.
 - 3) BOM bill of materials showing each product being submitted.
 - 4) List of deviations from specified components.
 - c. PDF index tabs per the electrical specifications by section and paragraph or equipment name e.g., provide a minimum of one tab section for each piece of equipment in all of the PART 2 PRODUCT Sections 2.01 - 2.**.
 4. Per the general submittal requirements in other sections of this specification and the following. The System Integrator shall develop and shall submit to the Engineer the following project data:
 - a. A detailed project schedule relating specifically to I&C - showing submittals, review time, long lead equipment, panel fabrication, expected site delivery date - startup, etc. highlight any anticipated critical path tasks. Provide a copy with the submittal and e-mail in PDF.
 - b. All shop drawings: (provide an electronic copy, in AutoCAD of all shop drawings on CD ROM to the Engineer with the submittals, revised submittals, and with final as-built drawings).

- c. Cut sheets for all products with a BOM - Bill of materials showing quantity, Manufacturer, catalog number, and the supplier name and phone number and relevant spec. paragraph number. Number each item in the bill of materials and relate the bill of materials to the submitted product index.
 - d. I/O checklist that verifies that all control and status/indication points in the control panels both implemented and spare have been tested. One copy of the I/O Checklist shall be submitted for the start of the Factory Test. One copy of the I/O Checklist shall be submitted prior to the Control system startup. The PLC Card drawings shall be used for this purpose.
5. Provide reference numbering on all cut sheets to relate them to the bill of materials. Provide same reference numbering by the equipment shown on the shop drawings.
 6. Provide a listing of all spare parts to be provided.
 7. NOTE: submittals received by the Engineer that are incomplete or not organized or do not conform to the specifications or do not have complete drawings as specified shall REJECTED and returned without review. Contractor should anticipate that submittals and re-submittals can take up to 3 weeks from the date mailed to the date returned with review comments if using standard submittal procedures.

1.07 COORDINATION WITH OTHER EQUIPMENT

- A. The System Integrator shall be responsible for obtaining all necessary information/product data (wiring diagrams, load data, etc.) for other equipment and instrumentation used in the project that requires integration into the power and control system – even for equipment and instrumentation outside the System Integrator's scope of supply. This may include, but is not limited to (standby generator, ATS, flow transmitters and other instrumentation, control valves, motor data, etc.).
- B. System wiring diagrams shall include information from other equipment.

1.08 NAMEPLATES

- A. Nameplates shall be provided on all electrical devices – (equipment, instruments, boxes, etc.).
- B. Nameplates shall also be provided on all electrical panel interior and exterior equipment (including but not limited to relays, I/O cards, circuit breakers, power supplies, terminals, contactors, switches, indicating lights, buttons, meters, and other devices.).
- C. Equipment nameplates shall have both the equipment name and number and equipment circuit number (if applicable).
- D. INSTRUMENT NAMEPLATES: Provide nameplates for all instruments with instrument name, number, and the ckt breaker, or fuse location for the power source. – for nameplates that cannot be attached to the instrument provide a stainless steel cable ring to attach it to the instrument.
- E. Nameplates shall be made of 1/16-inch thick machine engraved laminated phenolic having black letters not less than 3/16-inch high on white background or as shown on the drawings or other sections of the specifications. Nameplates on the interior of

panels shall be White Polyester with printed thermal transfer lettering and permanent pressure sensitive acrylic; TYTON 822 or approved equal. All nameplates shall include the equipment name and number (and function, if applicable).

- F. Relays shall be provided with 2 nameplates, one on the backpan by the relay base and one on the face of the relay.
- G. Provide warning nameplates on all panels and equipment which contain multiple power sources. Provide nameplates describing locations of power sources and disconnects. Provide any other warning or information nameplates as required by NEC or UL.
- H. Nameplates shall be secured to equipment with stainless steel screws/fasteners. Epoxy glue or other quality adhesive may be used where fasteners are not practical if first approved by the Engineer.

PART 2 PRODUCTS

2.01 GENERAL

- A. Design and Assembly:
 - 1. All equipment and materials utilized in the system shall be the products of reputable, experienced manufacturers with at least five (5) years' experience in the manufacture of similar equipment. Similar items in the system shall be the products of the same manufacturer.
 - 2. All equipment shall be of industrial grade and of standard construction, shall be capable of long, reliable, trouble-free service, and shall be specifically intended for control and monitoring of operation of motor-driven pumps and equipment.
 - 3. All equipment shall be of modular design to facilitate interchangeability of parts and to assure ease of servicing. All equipment, where practical, shall be of solid state, integrated circuit design.
 - 4. The system shall be completely assembled in the shop by the System Integrator. All components and equipment shall be prewired to the maximum extent possible.
 - 5. All components, including both internally and face-mounted instruments and devices, shall be clearly identified with phenolic nameplates of black background with white letters. Nameplates on the interior of panels shall be White Polyester with printed thermal transfer lettering and permanent pressure sensitive acrylic; TYTON 822 or approved equal.
- B. Interconnecting Wiring/Terminals:
 - 1. All conductors shall be stranded wire with thermoplastic insulation and shall be cabled to groups and supported so as to prevent breaking and to present an orderly arrangement and neat appearance. All outgoing wiring shall be terminated on a marked terminal strip capable of connection of at least 2 No. 14 wires and all terminal connections shall be numbered throughout the system.
 - 2. Terminal Numbering:
 - a. All field terminals shall have UNIQUE TERMINAL NUMBERS. This also includes NEUTRAL and LINE terminals shall be individually identified.

- (example NU1, NU2 .etc. for UPS neutrals N1, N2, etc. for normal power neutral terminals.
- b. Terminal numbers and wire numbers shall relate to the equipment or component number. For example – all PLC I/O terminal & wire numbers shall be the PLC rack/slot/I/O number.
3. In general: all field control wiring shall be #14 AWG. Internal wiring may be smaller #16 or #18 is acceptable as long as it is sized for the load and circuit protection.
 4. Wireways:
 - a. Provide wire ways as necessary in the enclosure to contain all internal wiring and all field wiring that exists on this contract with consideration given to future space and the future wiring. Size wireways such that there is ample room for the numbers of wires that will be wired to the terminals or terminal space in the cabinet plus room for an additional 30 percent future wire.
 - b. Provide corner wireways in the cabinet corners or as shown on the drawings.
 - c. Low voltage DC control and signal conductors shall be bundled separately from alternating current circuits. Separate raceways and wire gutters shall be dedicated for AC and DC wiring and labeled as such on the shop drawings. Wiring may cross at right angles if necessary. Special caution shall be used for PLC I/O card wiring and field terminations to accommodate the separation of AC and DC circuits. Intrinsically safe wiring shall be physically separated from non-intrinsically safe wiring.
 - d. Internal wiring shall be in separate wireways from the field wiring.
 5. All wiring and tubing crossing hinges shall be installed in a manner to prevent chafing. Bundles of similar conductors shall be clamped securely to the door and to the panel, and the bundles shall run parallel to the hinge for at least 12 inches. Spiral nylon cable wrap shall be provided in the hinge section of the bundle to fully protect the conductors or tubing against chafing.

2.02 PROGRAMMABLE CONTROL EQUIPMENT

- A. Programmable Logic Controller (PLC):
 1. The PLC shall be Siemens ET200SP series.
 2. Provide amount of PLC memory necessary for the control, monitoring and alarming of all station equipment and instrumentation plus an additional 20 percent spare.
 3. Provide PLC processors with on board Ethernet communications.
 4. Provide all PLCs with EEPROMS.
 5. PLC rack w/ spare slots – if applicable.
 6. 24VDC digital input cards.
 7. 24VDC digital output cards. All digital outputs shall interface with the output relay terminals.
 8. Analog input cards with individually isolated points.
 9. Analog output cards with individually isolated points.
 10. Note combination cards are not allowed except with special permission from the Engineer.
 11. Provide power supplies as required and recommended by the manufacturer.
 12. Spare and empty slots in the PLC rack shall be covered with a blank slot filler.
 13. Provide all necessary power supplies as required and recommended by the manufacturer.

14. Provide isolated fused circuit for power to PLC.
15. Spare and empty slots in the PLC rack shall be covered with a blank slot filler.

B. Additional I/O:

1. System Integrator shall provide all I/O necessary for the operations of the equipment and instrumentation for the project and as shown on the wire diagrams. The System Integrator shall provide additional I/O for the equipment and instrumentation that is outside of the System Integrators scope of supply, but still needs to interface with the control panel as described in PART 4 of this specification. Include the additional I/O when calculating the required spare I/O below.

C. Spare and Future, I/O:

1. **INSTALLED SPARE:** Provide all necessary analog and digital I/O for the project plus 20 percent installed spare, (round up to the nearest whole number) in each cabinet, provide terminals for all installed PLC I/O cards (including spares) to match the number of points in the card. For all spare I/O provide interface wiring to terminals.
2. Provide 1 spare fused disconnect for every 4 spare digital input terminals.
3. Spare digital outputs shall all be provided with interposing relays with one form C output wired to two terminals for a normally open contact interface.
4. For each spare analog input provide one fused, and two non-fused wired for a loop powered instrument input. Provide one shield ground terminal for every two spare analog inputs.
5. **FUTURE:** Provide spare space to the right of the PLC for at least two additional cards. Provide spare din rail for the additional terminals associated with the additional I/O cards (minimum of 12 inches for digital and 12 inches for analog terminals) and also account for the additional room in the wireways for the future wire.

2.03 COMMUNICATIONS EQUIPMENT

A. Ethernet Communication Module:

1. Provide Ethernet communications on the PLC processor for communications.

B. Ethernet Communications Switch:

1. All Ethernet switches used for this project shall be made by the same manufacturer.
2. Provide an Ethernet switch with ports as required as shown on the drawings plus 1 spare port. Ethernet switches shall be din rail mountable. The switch ports shall be configurable for either 10 or 100 base T. Phoenix or N-Tron or EtherTrak, or equal. Provide mounting and power circuits as required for the equipment.

C. Ethernet / Receptacle Interface Module:

1. Provide a combination Ethernet port/ 120V receptacle unit mounted with clear plastic hinged cover on the front door of each control cabinet with a PLC. So that the programmer can plug in without opening the cabinet door.

- D. Cell Phone Modem Equipment:
1. Provide one Verizon wireless services cell phone modem in the RTU for communications to the Headquarters:
 - a. Provide communications cables for interface to the Modem and PLC and Operator Interface.
 - b. Provide all necessary cables, fittings, bulkhead fittings, etc. for a complete cell/antenna installation.
 - c. Provide separate power supply rated for the modem requirements.
 - d. The system Integrator shall provide all necessary coordination, testing and troubleshooting with the phone company for modems to communicate between the PLCs.

2.04 PROGRAMMING OF PROGRAMMABLE CONTROLLER

- A. General:
1. The programmable controller equipment (Siemens PLCs, operator interfaces and SCADA shall be programmed by others and the programming cost shall not be included in the bid.

2.05 EQUIPMENT ENCLOSURES

- A. Cabinet Size:
1. Sizes of enclosure for the power and control cabinet shall be chosen by the System Integrator to provide ample space for the installed components and still fit within the given space in the structure. The enclosure shall be free standing.
 2. The enclosure minimum size shall be as shown on the drawings. With Engineer's approval, the Integrator shall upsize the cabinet if necessary, to fit in the components.
- B. Control Cabinets:
1. Indoor Control cabinets shall be NEMA 12 – powder coated steel construction with a drip shield.
 2. Outdoor Cabinets shall be NEMA 3R – Stainless Steel, or Aluminum – with Stainless steel hinge pins and door handles.
 3. Control cabinets in corrosive areas or chemical rooms shall be stainless steel or non-metallic.
 4. Provide all control cabinets with a drip shield.
 5. Cabinets shall be hinged with stainless steel pins.
 6. Cabinets shall be provided with a stainless steel 3 point latch.
 7. Provide all control cabinets with a data pocket and insert the cabinet drawings in the pocket when shipped to the site.
 8. Provide all control cabinets which house PLC equipment with a 12-inch x 12-inch folding shelf HOFFMAN A-CSHELF12 or approved equal. Also provide an Ethernet port and 120V receptacle with a hinged clear cover for laptop interface on the outside of control panel door.
 9. Provide corrosion inhibitors in all control cabinets prior to shipping Amount of inhibitor shall be provided for the volume of the enclosure for one year. HOFFMAN AHC series or approved equal.
 10. Enclosure shall be manufactured by Hoffman Products, Inc. or approved equal.

- C. Double Enclosures for Outdoor Areas:
1. The exterior panel shall be NEMA 3R made of aluminum (0.125 inch thick minimum) or 316 Stainless Steel with double flanged door frame on all four sides. All exterior seams shall be continuously welded or sealed. Provide enclosure with louver vents, vent fan and thermostat, heater, and thermostat. Exterior enclosure shall be Hennessy Products, Inc., or Hoffman free standing enclosure or equal with minimum size as shown on drawings.
 2. The interior enclosure(s) shall be NEMA 12 aluminum or powder coated steel construction equal to Hoffman standards and quality of manufacture. Enclosure sizes shall be a minimum of that shown on the drawings. Provide inner enclosure with vents, heater, and thermostat. Provide outer enclosure with outdoor rated vents with covers and filter, fan, and thermostat .
- D. Enclosure Door Latches:
1. Door latches on all enclosures shall be fast operating type 3-point latch door handle.
 2. NEMA 4 and 4X shall also have 3-point latch if possible, but where a 3-point latch will not meet rating requirements and for all types of enclosures that are too small for a 3 point latch use fast operating clamp assemblies. Hoffman Bulletin A-80 or equal. The latch handle shall operate toward the center of the panel to open the door and be pointing down when closed.
 3. Small boxes and control stations shall have 2 screwdriver or hand operated latches.
- E. Folding Shelf / Door Stop:
1. Provide a 12-inch x 12- inch folding shelf on the door to all cabinets with remote I/O or PLC's for supporting a laptop computer. Hoffman A-CSHELF12 or approved equal:
 - a. Mount the shelf so that when the cabinet is installed, the shelf will be 36 inches – 40 inches above the floor.
 2. On all cabinet doors with a folding shelf, provide a doorstop, Hoffman A-DSTOPK ALGSTOP-2 or approved equal.
- F. Wireways:
1. Provide molded plastic wireways, slotted for wire connections for all wiring in the panels. They shall be complete with covers. Wireways shall be manufactured by Panduit or Taylor or approved equal.
- G. Forced Air Heater:
1. Provide a fan-driven resistance heater (or as shown on plans) with 120 VAC line thermostat in each control enclosure which houses instruments, relays, PLC's, starters, or other solid state devices; located outdoors or in moist environments. The thermostat shall be adjustable between 40°F. and 80°F. Provide correct wattage and voltage for the required application. Heater shall be Hoffman bulletin D-85 D-AH series or approved equal.
- H. Strip Heater:
1. Provide a 100 watt (or as shown on the plans) resistance heater with 120 VAC line thermostat in each control enclosure located outdoors or in moist environments. The thermostat shall be adjustable between 50°F. and 80°F or preset at 60°F Provide heater with aluminum mounting plate for application in

a non-metallic enclosure. The heater shall be silicone rubber type as manufactured by WATLOW ELECTRIC , St. Louis, MO. or equal.

- I. Panel Light, Switch and Convenience Outlet:
 1. Provide two LED strip type lights with manual switch in control panels that contain a PLC rack , relays, or other equipment that would require troubleshooting or operator access for normal operation. Provide a simplex outlet, 120VAC 15A, in all panels that require a computer or other maintenance tools that may need a power source. These shall be on a separate dedicated circuit.

2.06 TERMINALS

- A. General:
 1. Provide terminals blocks arranged per the examples drawings and as described in this specification.
 2. PLC card – I/O terminal blocks shall be grouped together to match the terminal arrangement of the PLC card that they are connected to.
 3. TERMINAL NUMBERING:
 - a. Provide unique terminal numbers for all field wired terminals.
 - b. Terminal numbers and wire numbers shall relate to the equipment or component number or drawing number.
 - c. The drawings shall use drawing number references on all wires that connect between drawings or are shown on more than one drawing.
 4. Provide terminals for all wire connections to field wiring and internal power distribution. For all terminals (including line voltage and neutral terminals) that are used for wiring out to field devices provide unique terminal numbers.
 5. Provide terminals for all wire connections to field wiring and internal power distribution. For all terminals (including line voltage and neutral terminals) that are used for wiring out to field devices provide unique terminal numbers.
 6. Provide spare din rail space and spare terminals as indicated by the drawings or these specifications.
 7. For all energized circuits (power and control) powered from the panel and extend outside of the panel provide an individual fused terminal with appropriate fast blow fuse (1/2 amp for PLC inputs) and “blown fuse” indicator light for each circuit and unique terminal number.
 8. For all signal circuits that extend outside of the panel provide an individual fused terminal with appropriate fusing and integral blown fuse indication. All 4 to 20 mA circuits shall be individually fused with a 1/16 amp fast blow fuse: and blown fuse indicator.
 9. For all energized circuits powered outside of the panel which extend into the panel, provide a disconnecting terminal to isolate each individual circuit.
 10. Provide fusing of all DC circuits with appropriately sized fuses and blown fuse indicators.
 11. Analog loops that are 24 VDC powered shall have a knife switch to disable the loop.
 12. Connections shall have compression terminals capable of terminating 2 #14 AWG stranded wires. Terminals shall be DIN rail strip mounted Provide number strips for terminal blocks that are referenced by the wire marker. Provide bridge bars for jumpering between terminal blocks. Provide end clamps to separate and terminate terminal block groups. Provide end covers

for groups of terminal blocks in sets to match the number points associated with individual I/O cards in the PLC rack.

13. Provide Separation Plates on each side of terminals that are at a different potential or polarity than surrounding terminals.
14. Provide clear plastic DIN rail mounted nametag stanchions for each block of terminations. Each nametag shall hold a preprinted label designating the PLC rack and PLC card (slot) that terminates to that set of terminals.
15. Terminals shall be mounted such that there is a minimum of 2 inches of clear space on both sides of the terminal (between the terminals and the wireway); for ease of wiring and so that the entire wire tag will be visible outside the wireway.
16. Mount all terminals strips on 2 inch standoffs from backpan.
17. Provide wired terminals to match the number of points supplied on each I/O card in a cabinet.

B. General Purpose And Digital Input Terminals:

1. Terminal Blocks for general purpose and digital input terminations shall be Phoenix Contact UK 5, or equal. Provide UKK5 Double Hi, or equal, if space is limited.

C. Analog Input Terminals:

1. Terminal Blocks for use in analog input terminations shall be knife disconnect type, Phoenix UK 5-MTK , or equal.
2. Provide one ground terminal for every two analog inputs for grounding the shield.
3. Provide a fused terminal with a 1/4 amp fuse and blown fuse indicator for all analog inputs for loop power.

D. Analog Output Terminals:

1. UKK 5 Terminal blocks for analog outputs shall be fused, double hi with a separate ground terminal, or equal.

E. Digital Output Relay Terminals:

1. Provide interface/interposing relays for all digital outputs that extend out of the control panel and for all spare and future digital outputs. Relays shall be individual form C relays, or equal. Interface to digital output cards or relays as required to interface I/O module to DIN rail mounted relays, or equal.
2. Relay output cards are not to be used unless specifically allowed by the Engineer. All digital outputs shall interface with individual output relays. Panel mounted devices may be directly powered by the output card if approved by the Engineer.
3. Provide relays to match the number of points supplied on each digital output card in a cabinet.
4. Provide two descriptive labels for all relays. One label on the backpan and one label on the relay.

F. Fused Terminals:

1. Fuse terminal blocks shall be hinged disconnect level type with "blown fuse" indicators. PHOENIX CONTACT UK 5 HESI series, or equal.

- G. Test and Calibration:
 - 1. Provide 1 set for each Cabinet supplied plus 1 spare set consisting of:
 - a. Short Circuit Plug, 1 pair of Reducing Plugs, 1 pair of Test Adapters.

2.07 OPERATOR INTERFACE DEVICES

- A. All operator interface devices mounted on the panel front shall be rated for the environment in which they will be located. In general, devices mounted on indoor panels shall be NEMA 13 rated. Operator devices mounted outdoors, or in wet or corrosive environments shall be NEMA 4X rated.
- B. Alarm Beacons:
 - 1. Alarm Beacons shall be heavy duty industrial, Marine Rated, high intensity strobe with minimum 800K peak candle power – Edwards 105 series w/ 8 joule high intensity strobe. Provide mounting bases and attachments as required for the application.
- C. Selector Switches:
 - 1. Selector switches shall be for use on 120 volt control circuits. Contacts shall have a continuous current rating of 10 amperes both inductive and resistive. Selector switches shall be of the heavy duty oil tight type. Allen Bradley 800T, 800H, GE CR104P, Square D Type K or approved equal.
- D. Push Buttons:
 - 1. Push buttons and illuminated push buttons shall be for use on 120 volt control circuits. and shall have continuous current rating of 10 amperes both inductive and resistive. Pushbuttons for "emergency" "help" applications shall have maintained contacts and red mushroom head operators. Allen Bradley Bulletin 800T, 800H or approved equal.
- E. Indicating Lights:
 - 1. Indicating lights shall be push-to-test LED type. Illuminated pushbutton type with the pushbutton wired for the push-to-test function required. Appropriate lens caps shall be provided as shown.
- F. Operator Interface:
 - 1. Provide an operator interface. provide a minimum 7-inch color graphic display. Operator Interface shall be Siemens Simatic HMI TP 700 Comfort.
 - 2. Provide all necessary software and hardware for a complete system.
 - 3. Programming of the operator interface shall be done by others.

2.08 CABINET POWER DISTRIBUTION

- A. Control Panel Circuit Breakers:
 - 1. Control panel circuit breakers shall be thermal-magnetic type, supplementary overcurrent devices. Circuit breakers shall be snap mountable on rails. Circuit breakers shall be sized for actual circuit load. or as shown on the drawings:
 - a. Provide 2 spare installed 5amp circuit breakers or the number of spares shown on the drawings, whichever is greater. Wire breakers out to terminals and provide number of spare neutral terminals to match number of hot terminals.
 - b. Provide 2 spare "hot" terminals wired to the output of each spare breaker and 3 spare neutral terminals wired to the appropriate neutral.

2. Control panel circuit breakers shall be Allen-Bradley 1492-CB, or equal.
 3. In all control panels, provide a laminated drawing of the panel power distribution circuit breakers for referencing all circuit breakers in the panel.
- B. Grounding:
1. Provide 3 spare ground terminals in each cabinet.
 2. Provide a ground bus in each cabinet – minimum 6 inches long with screw terminals for grounding equipment and instrumentation.
- C. Fuses:
1. Provide, fuse pullers; (one for each type of fuse), for removal of fuses.
 2. Provide blown fuse indicators on all fuses.
- D. Power Supplies – Redundant Pair:
1. Power supplies shall be switching type, voltage, & sized to be able to supply the demand. Units shall be closed frame DIN rail type and have overvoltage and overcurrent protection. Units shall have LED power on light and 2 sets of output terminals. Power supplies shall be sized for the load plus an additional 30 percent IDEC, SOLA Power Supply or equal.
 2. Power supplies shall be installed as a redundant pair. Provide one supervised power supply fail contact input for each power supply to the PLC for alarming.
 3. Provide one fused and one non fused terminal for all DC circuits that extend outside the cabinet. Provide spare DC terminals for a minimum of 2 additional DC circuits or 20 percent whichever is the greater amount.
 4. Provide one redundant pair of power supplies at 14VDC for the radio and one redundant pair at 24VDC for the instrumentation and I/O power.
 5. Provide redundancy module for true power supply redundancy / sharing of load between the redundant pair – SOLA or equal.
- E. 24VDC Uninterruptible Power Supply (UPS):
1. 24VDC uninterruptible power supply (UPS) shall be a continuously on-line. Unit shall be 24VDC and maintain on battery backup for a minimum of 10 minutes. Unit shall be din rail mounted wired to control system power. The UPS capacity/rating shall be chosen by the System Integrator for the load being served plus 20 percent.
 2. PULS, Allen-Bradley 1606.XLS series, size chosen for the application or equal.
 3. Provide UPS alarm module and provide all necessary wiring and relays for connection to the UPS to provide 2 normally closed contacts which open upon loss of power for the PLC digital inputs for: a) loss of input power to the UPS and b) for a battery alarm.
 4. Provide labeling to differentiate UPS power circuits vs. non UPS powered circuits by adding a “U” suffix on the terminal name:
 - a. Provide 2 spare installed 5amp UPS circuit breakers or the number of spares shown on the drawings, whichever is greater.
 - b. Provide 3 spare “hot” terminals wired to the output of each spare UPS breaker and the same number of spare neutral terminals wired to the appropriate neutral.
 5. UPS Installation: The unit shall be din rail mounted.

- F. 120VAC Uninterruptible Power Supply (UPS):
1. 120VAC uninterruptible power supply (UPS) shall be a continuously on-line. Unit shall be sized to operate on a 120 VAC 60 Hz. feeder and maintain 120 VAC load on battery backup for 5 minutes. Unit shall be din rail mounted wired to control system power. The UPS size shall be chosen by the System Integrator for the load being served plus 20 percent. If the load requires two UPS units then provide two units and two bypass switches and separate the loads such that one unit carries all of the instruments and the other carries all of the other loads.
 2. UPS shall include built in transient voltage surge suppresser (UL 1449) with a THD less than 5 percent at full load, for clean power to the PLC, power supplies and other power sensitive equipment. UPS shall include user interface with indication of battery condition, capacity, and programmable operating parameters. Provide battery replacement warning. Allen-Bradley 1609, APC or equal.
 3. Provide UPS alarm module and provide all necessary wiring and relays for connection to the UPS to provide 2 normally closed contacts which open upon loss of power for the PLC digital inputs for: a) loss of input power to the UPS and b) for a low battery alarm.
 4. Provide separate 120 volt hot and neutral terminals for UPS circuits.
 5. Provide labeling to differentiate UPS power circuits vs. non UPS powered circuits by adding a "U" suffix on the terminal name:
 - a. Provide 2 spare installed 5amp UPS circuit breakers or the number of spares shown on the drawings, whichever is greater.
 - b. Provide 3 spare "hot" terminals wired to the output of each spare UPS breaker and the same number of spare neutral terminals wired to the appropriate neutral.
 6. UPS Installation: The unit shall be din rail mounted Bypass circuitry shall be provided with a bypass switch.

2.09 RELAYS

- A. Relay Labels:
1. Provide two labels for all relays one label on the backpan and one label on the front surface of the relay.
- B. Relays for General Purpose:
1. Relays for general purpose shall have appropriate coil voltage for the application, contacts (amp and voltage) shall be rated for the application, minimum 2 amps. All relays shall have an integral indicating light to show if there is coil voltage present. They shall have pin/blade base and matching socket. Units shall be Allen-Bradley 700 type HA, HB, or equal.
 2. Appropriate relay (coil voltage and contact load ratings) shall be selected based on application from the control wiring diagrams and load served.
- C. Time Delay Relays:
1. Time delay relays shall be multi-function, multi-range with plug-in base ,pin style terminations timing and timed out LED indicators, and calibrated scales. Relays shall have minimum 0.5 seconds to 60 minutes, 8 selectable timing ranges, 5 amp contacts. Select coil voltage for the application. Minimum accuracy requirements (plus or minus) shall be as follows: 1) Repeat accuracy 1/2 percent 2) Timing change over full voltage range 1/2 percent

change over full temperature range 2 percent 3) Scale tolerance 5 percent.
Allen-Bradley Bulletin 700 type HR series; or equal.

D. Digital Output Relays:

1. All digital outputs shall be provided with interposing relays wired out to terminals - including spares. Relays shall be group mounted with connecting cable to the PLC output card. Output relays can be single pole, N.O. or N.C. for the application – all Spare DO relays shall be form C with the N.O. contact wired to terminals.

2.10 INSTRUMENTATION

A. General Requirements Of Instrumentation:

1. All Instruments, switches and control sensors shall be rated for the environment in which they will be located. In general, devices mounted indoors shall be NEMA 12 rated. Devices mounted outdoors, or in wet or corrosive environments shall be NEMA 4X rated.
2. Devices mounted in hazardous areas shall be rated for the classification of the area that they are located:
 - a. Provide barriers, intrinsically safe relays, explosion proof boxes, or other equipment, if necessary, to rate equipment for the environment installed.
 - b. Provide seal fittings per NEC.
3. Transmitters shall be indicating type when available and shall have local or direct reading indicators, unless otherwise shown:
 - a. Provide a pressure gauge for every pressure switch and transmitter.
4. Select range of instruments for the application.
5. Transmitter input power shall be 120VAC 60HZ unless otherwise shown, output shall be 4-20 mA into a minimum 500 ohm load.
6. For each instrument that has a separate power source, provide a power disconnect switch (rated for the environment and the application) mounted next to each instrument.
7. Transmitters located outdoors shall be provided in an enclosure with a heater or provided with thermostat controlled heaters in their enclosure.
8. Instruments shall automatically reset and resume normal operation after power interruption without manual resetting.
9. Instrument cords (for example: cords between the sensor and the transmitter) shall be provided:
 - a. With length sufficient for the application.
 - b. With rating for the environment installed.
10. Terminate all wiring on terminal strips, splicing wiring is not acceptable.
11. Wire that terminates on screw type terminals shall be provided with a spade or loop type end connector.
12. For all Indicating transmitters that are mounted inside enclosures, provide a window in the enclosure so that the display can be viewed without opening the enclosure.
13. Instrumentation supplier shall provide installation inspection, calibration and training as required for proper installation.

B. Door-Switches:

1. Provide door/hatch/cover security switches at locations indicated on the plan drawings. Switches shall be limit switches with lever arm as required for the

application Square D class 9007 or approved equal. Install such that the switch contacts are closed when the door/cover is closed.

C. Limit Switches:

1. Limit switches shall be heavy duty oiltight Square D Class 9007 Type T or approved equal with lever arm required for the application. Submit details of installation for review prior to field construction.

D. Drywell Liquid Level Switches (Flood Switch):

1. Provide drywell liquid level switch, hermetically sealed, magnetically actuated, snap action, 15W, 120V SPST, N.C. (dry). TRANSAMERICA DELAVAL - GEMS LS-1900 or 1950 chosen for the environment or approved equal.

E. Pressure Switches (Indicating):

1. Pressure switches shall have a built-in with two external adjustments of pointers for hi and low setpoints with a visible calibrated dial that is viewable without opening the housing. Switches shall have two dry contact outputs (one for hi and one for low) rated 120V for interface to the control system. Provide pressure range for the application. Provide housing for the environment. Switch shall be mercury hermetically sealed tilt tube. Dwyer, Mercoid Series DA/DS Bourdon Tube Pressure Switches, no equal.
2. Provide all pressure switches with an isolation valve and TEE fitting with a test port for calibration.
3. If not already specified, provide a 4 inch Gauge mounted next to the pressure switch.

F. Pressure Switches (Indicating):

1. Pressure switches shall have a built-in indicating gage with two external adjustments of pointers for hi and low setpoints. Switches shall have two dry contact outputs (one for hi and one for low) rated 120V for interface to the control system. Provide pressure range for the application. Provide housing for the environment. DWYER PHOTOHELIC SERIES 3000 AND 43000 or equal.

G. Pressure Transmitters:

1. Unit shall be pipe or wall-mounted, with weatherproof/dusttight (NEMA 4X) housing transmitting a proportional 4-20 mA signal with zero and span adjustments and adjustable damping.
2. Housing- Epoxy-coated cast aluminum. Wetted Parts 316SS. Accuracy shall be 0.2 percent or better of set span. Long term stability of 0.1 percent or better. Adjustable measuring range with TD 10:1.
3. Provide with integral 4 digit indicator calibrated in PSI for pressure applications and feet for level applications. Foxboro IGP10/20, OMEGA- PX764, Endress-Hauser CERABAR M or equal.
4. Provide a differential pressure unit if the device is measuring water level or if applicable for the application Foxboro IGP20, Endress-Hauser CERABAR D or equal.
5. Provide all pressure transmitters with an isolation valve and TEE fitting with a test port for calibration.
6. If not already specified, provide a 4 inch Gauge mounted next to the pressure transmitter.

- H. Pressure Gauges (For Pressure Transmitters):
1. Provide a pressure gauge for each pressure switch and transmitter. Mount gauge near sensor or as shown on the drawings. Pressure gauges shall be provided with a range and working rating for the application. Gauges shall be stainless steel with 4 inch face and minimum 1 percent accuracy. Noshok 400/500 series or approved equal.
- I. Pressure Switch/Transmitters – Test & Isolation Valve:
1. For each pressure switch and transmitter supplied, provide one Test & Isolation valve assembly. Assembly shall include an isolation valve and test valve and shall be included in the supply (BOM) with each pressure switch and each pressure transmitter.
- J. Pressure Gauges (For Pressure Transmitters):
1. Provide a pressure gauge for each pressure switch and transmitter. Mount gauge near sensor or as shown on the drawings. Pressure gauges shall be provided with a range and working rating for the application. Gauges shall be stainless steel with 4 inch face and minimum 1 percent accuracy. Select range and units for the application Noshok or equal.
- K. Magnetic Flowmeter:
1. Provide a magnetic flow meter for each location shown on the drawings and / or listed below.
 2. Magmeter shall be Siemens, Fischer & Porter Series 3000 or Endress & Hauser PRO-MAG Meter/Element or equal.
 3. Specifications:
 - a. NEMA 4X enclosure rated for accidental submergence in water up to 30 feet for 48 hours.
 - b. Ground rings, or probes for meters if recommended by the mfr.
 - c. Bi-directional flow capable.
 - d. Accuracy of +/- 1 percent for flow velocity between 3 & 31 fps.
 - e. Magmeters shall be hydraulically calibrated at the manufacturer's facility against a master meter traceable to the NBS. A printout of the calibration data and calibration curve shall be furnished with each magmeter.
 - f. Power input 120VAC, output 4-20mA.
 - g. Dry contact closure for every X gallons of flow [where X = max flow of meter (gpm) / 10] – for accurate flow reading into the PLC. Contact shall remain closed for a minimum of 3 seconds.
 4. Features:
 - a. Flange material: 304 stainless steel.
 - b. Liner: Teflon.
 - c. Electrodes: 316 stainless steel.
 - d. Separate transmitter with digital indicator (readout in GPM or MGD as directed by the Engineer).
 5. Mounting: The transmitter, transducer, and sensor shall be mounted per the requirements of the drawings and the manufacturer:
 - a. Provide all necessary mounting hardware for each application including:
 - 1) 1/4 inch stainless steel mounting plate for each transmitter.
 - 2) Provide cable for interface between flow tube and flow transmitter.
 6. Substitutions: Not accepted.

- L. Control Power Transformers:
 - 1. Each motor starter, soft starter, VFD etc. shall be equipped with its own individual control circuit transformer, 120 VAC secondary with primary and secondary fuses and blown fuse indicators. The transformer shall be sized to accommodate the contactor(s) and all connected control circuit loads. The transformer size shall also accommodate any devices connected or shown on the drawings as being served by the control circuit transformer.
 - 2. VFD control wiring shall be source wiring – control power shall be from the VFD source output. – typically, 24VDC source output from the VFD.
- M. Transient Suppressors:
 - 1. Provide all contactor coils with transient suppressors to limit the high voltage transients produced when power is removed from the coil. CUTLER HAMMER - C320AS1 or equal.

2.11 CIRCUIT BREAKERS

- A. Circuit breakers shall be molded case thermal-magnetic type. Circuit breakers other than those mounted in the panelboard shall be capable of being padlocked in the open position. Circuit breakers shall be quick-make and quick-break type. They shall have wiping type contacts. Each shall be provided with arc chutes, individual trip mechanisms on each pole. Two and three pole breakers shall be common trip. All breakers shall be calibrated for operation in an ambient temperature of 40 degree C. Molded case circuit breakers shall be trip-free. Each breaker shall have separate trip indication independent of the ON or OFF positions:
 - 1. Provide all 480V breakers with adjustable thermal trips. Provide adjustable trips on breakers, in addition, as shown on the plans.
 - 2. Breakers shall have lugs UL listed for both copper and aluminum.
 - 3. Breakers shall have the interrupting rating and trip rating indicated on the drawings.
 - 4. All breakers for motor starters shall include auxiliary contacts which open when the breaker in the OFF position.
 - 5. Provide service entrance rated breakers if required for the application by NEC.
- B. Provide interface options for control, monitoring, and alarming as shown on the drawings and the wire diagrams. Manufacturer shall select the size and rating as required for the application.

2.12 DRY TYPE TRANSFORMERS

- A. Provide dry type transformers in accordance to applicable requirements of Section 26_05_00 - Miscellaneous Electrical.
- B. Where the one-line diagram calls out for isolation transformers; provide noise suppresser isolation transformers, Square D/Topaz Class 7610 or equal.

2.13 SURGE ARRESTORS

- A. Provide Surge arrestors , with indicators, where shown on the one-line diagrams to protect against overvoltage transients. JOSLYN J9200 series with protective capacitor GE model 9L18 or equal. Select proper components for the application as shown on the drawings.

2.14 OPERATING MECHANISMS / MOTOR LOCKOUT

- A. The main disconnect/circuit breaker/fuse shall be provided with a lockable external "thru-the-door" operating handle with bypass. Square D Class 9422 or equal.
- B. Each Individual motor circuit breaker or disconnect shall be provided with a lockable external "thru-the-door" operating handle with bypass. mechanism for locking in the open position to meet the lockout/tagout requirements per the NEC.

2.15 WIRE MARKERS:

- A. Field installed wire markers shall be T&B, SHRINK-KON HVM or approved equal.

2.16 SPARE PARTS STORAGE BOX

- A. Provide one portable spare parts storage box (approx. 21 inch x 12 inch x 13 inch) Heavy duty, non-metallic. DEWALT Tough System DS 300 Large Storage Unit or equal.

2.17 SPARE PARTS

- A. In addition to spare parts mentioned elsewhere in this section, the Contractor shall supply the following spare parts for use by the Owner: All spare parts shall be shipped with the equipment:
 - 1. Qty 1 spare PLC processor to match, complete with Ethernet communications and all other options.
 - 2. Qty 1 spare (non-installed) PLC input and output card of each type used.
 - 3. Qty 1 spare power supply of each type and rating used.
 - 4. Qty 1 Relay of each type used or 10 percent whichever is the greater amount.
 - 5. Qty 10 lamps of each type used or 100 percent whichever is the greater amount.
 - 6. Qty 200 percent spare fuses (two spare fuses for each fuse supplied).
 - 7. Provide 10 spare nameplates 3 inches square or less with 20 letters 1/2 inch or less to be specified by the owner.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. The instrumentation and control system shall be installed, in accordance with the contract drawings, installation details, and also instructions prepared by the System Integrator, and per special instruction from equipment or instrumentation Manufacturers.
 - 2. The Integrator shall provide detailed installation drawings and wiring diagrams for this purpose.
 - 3. Installation shall include all elements and components of the I&C system and all conduit and interconnecting wiring between all elements, components, and sensors.

4. Provide instrument calibration sheets for all instruments to verify function, range, setpoints etc.:
 - a. For analog instruments include range information and test at 0, 25 percent, 50 percent 75 percent and 100 percent. Unless otherwise shown set displays as follows – for level measurement in FEET, for pressure in PSI, for flow GPM.
 - b. For switches verify operation and check setpoint for correct operation – for floats verify trip level, pressure switch settings, etc.
- B. Wire And Cable Termination:
1. Stranded control conductors may be directly terminated using compression type terminals at control panels. Special instrumentation cables shall be terminated in accordance with the recommendations of the Manufacturer of the equipment and subject to review by the Engineer.
 2. No splices shall be used in power, control and/or signal wiring. The wiring shall be continuous from point-to-point.
 3. Terminals and connectors shall be installed with the compression tool recommended by the terminal Manufacturer.
 4. Any control or signal wire landing on a screw terminal shall be terminated with a spade or loop connector.
 5. All wire and cable shall be provided with a wire tag at each termination in accordance with the wire tagging requirements in the specification.
 6. Terminals shall be installed such that there is a minimum of 2 inches clear space between the terminal strip and the wireway on both sides of the terminal, for ease of wiring.

3.02 CONTROL PANEL DESIGN & FABRICATION

- A. General:
1. Panels shall not be fabricated until Engineer has reviewed and approved the submittals or the integrator has written authorization from the Engineer to construct the panels. It shall be the integrator's responsibility to inform the Engineer in writing if there are limited time constraints that need to be met to start the panel fabrication to meet contract deadlines.
- B. General Layout:
1. Provide separate wire ways for field wiring and for internal wiring. Provide separate wireways for 120V and DC circuits. Mount PLC at top of control section, Mount digital input and output wireways and terminals on the left hand side and analog I/O terminals and wireways on the right side with power distribution down the middle of the control area. See drawings.
 2. For control panels that contain motor control power equipment: In general, the power distribution shall be located toward the left side of the cabinet and the PLC and other control components shall be separate and located in the right side of the cabinet. If power and controls are in the same cabinet, then provide at least 4 inches of separation between any 480V power wiring or components and the signal wireway or provide a steel barrier between the power and controls sections.
 3. If panel has intrinsic safe component area – provide space below the UPS in the center of the cabinet at the bottom.

- C. Operating Device Location:
 - 1. Operating devices shall be mounted no higher than 6 feet – 4 inches and no lower than 4 feet - 0 inches above finished floor when panel is installed unless otherwise approved by the Engineer. Operating devices with displays (such as PLC interface, VFD interface, and power monitoring devices) shall be mounted so that the center of the display is between 4 feet - 6 inches and 5 feet - 0 inches above finished floor unless otherwise approved by the Engineer.

- D. Power Components:
 - 1. Provide lockable breakers for all motor load circuits to meet NEC lockout tagout requirements.
 - 2. Provide cabinet power disconnect / door interlocking mechanism as required by UL, NEC, and any other authority.
 - 3. Provide service entrance rated breaker if required for the application.
 - 4. Provide all individual motor starters and VFDs with their own electrically isolated 120V control power transformer (CPT) or 120V control power circuit derived from the load side of the motor starter circuit breaker. Control power circuit for hand control shall be from the CPT so that motor load can be run manually when auto control power circuits have failed.

- E. Control Cabinets:
 - 1. Install PLC I/O card to terminal interface wiring with pre-manufactured, multi-conductor or bundled wire.
 - 2. Install all terminals on 2 inch standoffs.
 - 3. Terminals shall be installed to allow a minimum of 2 inches of clear space between the terminal and the wireway or any other components.
 - 4. Coordinate terminals and wireway locations to account for the location of the conduit entrances into the cabinet.
 - 5. Wire ways shall be 3 inches deep, width shall be chosen for the application.
 - 6. Provide separate wire ways for internal and field wiring.
 - 7. The UPS shall be din rail or shelf mounted – maintain at least 2 inches space between the bottom of the UPS and the bottom of the cabinet for field wiring.
 - 8. Provide right angle connectors on cables if the cable connection prevents closing of access doors on equipment within the cabinet or on the control cabinet itself.

3.03 FACTORY TESTING & INSPECTION

- A. Prior to delivery to the site, the Power & control panels shall be tested by the System Integrator, all control devices shall be operated and the cabinet shall be powered with rated incoming voltage for at least 2 days. Simulating equipment shall be provided and wired into the control cabinet system for this testing. The entire control system shall be interconnected as it will be installed in the field if the actual equipment is not available, then simulation equipment shall be provided to fully demonstrate the functionality of the system. The System Integrator shall test all functionality of the system and verify proper operation of the hardware and software

- B. Following the System Integrators testing, the Power & control panel shall be tested and inspected by the Design Engineer prior to shipment to the project site. The testing shall include, but not be limited to, operation of all input and output (I/O) points, control devices and motor controllers and demonstration of all control

functions with the actual equipment or via a simulation. The System Integrator shall revise, modify, adjust the system as required by the Engineer during the testing period. The System Integrator shall inform and coordinate the time of the testing with the Engineer at least 4 weeks prior to the testing date.

- C. The System Integrator shall provide working space, a 6 foot table and 2 office/desk chairs for the test Engineers.

3.04 STARTUP AND TESTING

- A. All components of the control system shall be calibrated by the Manufacturer after completion of installation. Each component shall be adjusted to be within the Manufacturer's required range and for the specific application.
- B. Components that cannot be properly calibrated or that are found to exceed the Manufacturer's specified range or accuracy shall be removed and replaced at no additional cost to the Owner.
- C. The control system shall be placed into operation by the Contractor and System Integrator.
- D. All components shall be tested and recorded on check-off forms and shall be witnessed by the Engineer.

3.05 FIELD TESTING OF THE CONTROL SYSTEM

- A. General:
 - 1. When the installation is substantially complete, the Contractor shall commence field testing of the control system. This shall determine that all system components connect up correctly to each other so that the system works as designed.
 - 2. Field testing of the control system shall take place in 4 phases:
 - a. Continuity Testing.
 - b. I/O Testing.
 - c. Program Testing.
 - d. System Validation Testing.
- B. Continuity Testing:
 - 1. As equipment wiring is completed, the Contractor and Hardware Integrator shall perform a continuity test for every control to determine terminal to terminal continuity and verify all control and signal wiring is installed in accordance to the Hardware Integrators wiring diagrams.
- C. I/O Testing:
 - 1. The entire I&C system shall be I/O tested.
 - 2. Prior to calling for I/O testing the Contractor shall:
 - a. Complete the continuity testing.
 - b. Label all wire at both ends.
 - c. Submit all associated test and calibration forms (Instrument, motor, wire, etc.).
 - d. Run all motors (in HAND) to verify correct operation and rotation.
 - e. Provide all equipment and instrument labels per spec.
 - f. Test operation of "packaged sub systems."

3. Prior to any equipment to be put into automatic operation, every digital and analog input and output shall be tested for correct operation and witnessed by the Electrical Engineer. The contractor shall provide a set of the PLC Card drawings and instrument and control wiring diagrams on 8 1/2 inch x 11 inch sheets for a check-off list of all inputs and outputs. If a point cannot be verified within 5 minutes of starting the check that point shall be noted as a punch list item to be corrected and re-tested at a later time.
 4. Definition: Successfully I/O Tested. A piece of equipment of system shall be considered "successfully I/O tested" when all of the I/O for that equipment has been tested and verified by both the programmer and the Electrical Engineer and checked off of the wiring diagrams or PLC I/O card drawings. Note: The Electrical Engineer must witness and verify all I/O testing.
 5. Once all I/O associated with a piece of equipment of system has been successfully tested, then the equipment or system will be deemed ready for program testing.
 6. Inputs:
 - a. The Contractor shall simulate an actual field condition whenever possible to provide both the digital and analog signal inputs into the PLC and these will be verified by the programmers. Where an actual field simulation is not practical, then the Contractor shall jumper the digital inputs at a point closest to the field device as possible and shall use an analog loop simulator for analog inputs.
 - b. Analog inputs shall be tested at 0,25 percent, 50 percent, and 100 percent of full range.
 7. Outputs:
 - a. The programmer will simulate outputs from the PLC and the Contractor shall verify the field operation of the output. The field operation verification shall be by actual operation of equipment when possible. When actual field operation of equipment is not practical for verification, then the Contractor shall use volt and amp metering to verify digital and signal outputs.
 - b. Analog outputs shall be tested at 0,25 percent, 50 percent, and 100 percent of full range.
- D. Program Testing:
1. The Contractor shall provide field support to the programmer for testing of the program. The Contractor shall provide field simulation of equipment as needed by the programmer to test all monitoring and alarm functions of the programming. The Contractor shall anticipate that the program testing will require up to a total of 40 hours of field support time for this project. The cost for this time shall be included in the bid.
- E. System Validation Testing:
1. After the program testing is complete, validation testing shall be by the Hardware and Software Engineer and Contractor, with the Owner and Engineer present. Validation testing shall include operation and verification of all control components and features of the entire control system.
 2. The Contractor shall simulate various field conditions to test all control operations, monitoring and alarms for all systems and equipment.
 3. The Contractor shall inform the Engineer of the testing schedule at least one week prior to the commencement of testing. Validation testing shall be

considered complete when the Owner and Engineer have determined that all of the original system requirements have been met.

4. The System Integrator shall revise, modify, adjust the system as required during and following start-up to provide the operation required by the contract documents.
5. Note: The Engineer shall not be called out by the Contractor for validation testing on equipment until all components are installed, all wiring points have been checked, and operation has been tested and verified by the Contractor.

3.06 COMMISSIONING

- A. Once all systems have passed validation testing, then the facility will be operated for 2 weeks or time period as determined in the documents to verify all component and system operations prior to final acceptance.

3.07 SYSTEM MAINTENANCE

- A. The System Integrator shall be responsible for maintenance of the system from time of start-up to the date of acceptance, by formal action of the Owner, of all work under the contract. The System Integrator shall correct deficiencies and defects and make any and all repairs, replacements, modifications, and adjustments as malfunctions or failures occur. The System Integrator shall perform all such work required or considered to be required by the Owner to cause and maintain proper operation of the system and to properly maintain the system.

3.08 SERVICES OF SYSTEM INTEGRATOR

- A. General: An authorized service representative of the control panel System Integrator shall be present at the Site for two Days to furnish the services listed below. For the purpose of this paragraph, a Day is defined as a 6 hour period excluding travel time.
- B. Inspection, Startup, Field Adjustment: The authorized service representative shall supervise the following and certify the equipment and controls have been properly installed, aligned, and readied for operation:
 1. Installation of the equipment.
 2. Inspection, checking, and adjusting the equipment.
 3. Startup and field testing for proper operation.
 4. Performing field adjustments such that the equipment installation and operation comply with requirements.
- C. Instruction of Owner's Personnel: The authorized representative shall instruct the Owner's personnel in the operation and maintenance of the equipment, including step by step troubleshooting with test equipment. Instruction shall be specific to the equipment models provided. Training shall be scheduled a minimum of 2 weeks in advance of the first session. Training shall include individual two sessions for 2 shifts of plant personnel (2 hours for each session).
- D. Proposed training materials shall be submitted for review, and comments shall be incorporated. Training materials shall remain with the trainees. The Owner may videotape the training for later use with the Owner's personnel. The Hardware Integrator shall conduct specifically organized training sessions in operation and maintenance of the control system for personnel employed by the Owner. The

training sessions shall be conducted to educate and train the personnel in maintenance and operation of all components of the control system. Training shall include, but not be limited to, the following:

1. Preventative maintenance procedures.
2. Trouble-shooting.
3. Calibration.
4. Testing.
5. Replacement of components.
6. Automatic mode operation.
7. Manual mode operation.

3.09 OPERATION AND MAINTENANCE DATA

- A. The System Integrator shall prepare and assemble detailed operation and maintenance manuals in accordance with the project general requirements. The manuals shall include, but not be limited to, the following:
 1. Preventative maintenance procedures.
 2. Trouble-shooting.
 3. Calibration.
 4. Testing.
 5. Replacement of components.
 6. Automatic mode operation.
 7. Manual mode operation.
 8. System schematics / shop drawings.
 9. Electronic copy on CD ROM of all shop drawings in AutoCAD version 2000 or newer.
 10. As-built wiring diagrams of cabinet and enclosure contained assemblies.
 11. Catalog data and complete parts list for all equipment and control devices.
 12. Listing of recommended spare parts.
 13. Listing of recommended maintenance tools and equipment.
- B. 2 copies of the entire O&M manual shall be provided in electronic PDF format on Thumb drives.

3.10 RECORD DRAWINGS

- A. The System Integrator shall be responsible to provide a clean and neatly marked up set of record drawings showing any changes from the submittal and contract drawings. These drawings shall be provided prior to final approval of the project and release of the retainage.

PART 4 WIRING DIAGRAM EXAMPLES

4.01 GENERAL

- A. The wiring diagrams shall be drawn and submitted in accordance with the following example drawings. These drawings are for drawing formatting reference only and do not necessarily have any actual application to the facility control system.

4.02 EQUIPMENT WIRING DIAGRAMS (LOOP DWGS)

- A. Provide one page wiring diagram for each motor / equipment load showing all of the control wiring associated with that load. Drawing shall show the motor control center wiring , field wiring, PLC I/O, and control panel wiring all on one sheet; complete with terminal numbers and wire numbers. Include PLC Card information rack and slot and I/O designation for each point.

4.03 INSTRUMENT WIRING DIAGRAMS (LOOP DWGS)

- A. Show all wiring associated with each instrument on one page – including power supply location and signal wiring. Show all terminals numbers and wire numbers. Designate boundaries between field and control panels and etc.

4.04 NETWORK DIAGRAM

- A. Provide detailed drawings showing all of the components of the communications network – include all terminals and wire numbering. Designate equipment locations.

4.05 PLC I/O CARD DRAWINGS

- A. Provide I/O card drawings for all PLC I/O cards per the example drawing. Drawings shall show details specific to each I/O card, name of each input or output, reference drawing number for associated EQUIPMENT AND INSTRUMENT WIRING DIAGRAM, card number, slot number, control panel terminal and wire numbers, etc.

END OF SECTION

ATTACHMENT: EXAMPLE DRAWINGS #1 TO 7

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SECTION 43_33_20.01

LIQUID CHEMICAL DIAPHRAGM-TYPE METERING PUMPS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Positive displacement, diaphragm metering pumps; accessories, drives, and control panel requirements for pumping chemical solutions.
- B. Tag numbers:
 - 1. As specified in Pump Skid Schedule.

1.02 REFERENCES

- A. International Society of Automation (ISA):
 - 1. ISA 5.4 - Instrument Loop Diagrams.
- B. National Electrical Code (NEC).
- C. National Electrical Manufacturer's Association (NEMA):
 - 1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).
- D. NSF International (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects.

1.03 DEFINITIONS

- A. NEMA: Type 4X enclosure in accordance with NEMA 250.

1.04 SYSTEM DESCRIPTION

- A. General: Provide mechanically actuated, positive displacement, diaphragm type chemical metering pumps, accessories, and other items required for a complete and operational system. Each chemical metering pump system shall include, but not be limited to, the following items, which shall be supplied by the chemical metering pump manufacturer:
 - 1. Pumps.
 - 2. Control panels.
 - 3. Calibration columns.
 - 4. Pulsation dampeners.
 - 5. External pressure relief valves.
 - 6. Diaphragm back pressure valves.
 - 7. High pressure switches.
 - 8. Pump skid.
 - 9. Pipe and isolation valves.
- B. Fluid characteristics:
 - 1. Sodium Hypochlorite:
 - a. Dry chemical formula: NaOCl.

- b. Solution concentration: < 1 percent by weight.
 - c. Solution pH: Greater than 9.5.
 - d. Solution specific gravity: 1.1.
- C. Design requirements:
- 1. Pump:
 - a. Dry self-priming, capable of being run dry without damaging effects to pump.
 - 2. Motor characteristics: As specified in this Section.
 - 3. Supports:
 - a. Provide pump and driver supported on a common base.
 - b. Design anchor bolts to withstand a minimum of 1.5 times the maximum imposed operating loads or 1.0 times the imposed seismic loads, whichever is greater.
 - 4. Pump skid:
 - a. Mount pumps, valves, calibration columns, and appurtenances on a skid as specified in this Section and indicated in the Drawings.
- D. Performance requirements:
- 1. Systems shall deliver the pressures and volumes listed for their respective services in the Pump Skid Schedule.
- E. Product requirements as specified in Section 01_60_00 - Product Requirements - Plant.

1.05 SUBMITTALS

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
- 1. Design data, test reports, certificates, manufacturer's instructions, manufacturer's field reports:
 - a. Chemical feed pumps:
 - 1) Submit calculations for each pumping system:
 - a) Confirm scheduled values or recommend new pressure setpoints for the backpressure valves and pressure relief valves listed in the Pump Skid Schedule.
 - 2) Submit calculations for each metering pump showing the suitability of each pump for the suction and discharge conditions of each application point.
 - 3) Submit calculations recommending dimensions of pulsation dampener indicated on the Drawings.
- C. Shop drawings:
- 1. Provide a list of parameters, ratings, or other characteristics where the proposed chemical feed systems deviate from the requirements.
 - 2. Dimensions, including anchor bolt layout, materials of construction, size, weight, and performance data.
 - 3. Drawings: Provide electrical and instrumentation drawings showing coordination with electrical control devices operating in conjunction with the associated feed system.
 - 4. Dimensioned inlet and outlet connections.

5. Current NSF 61 Certification for components to be in contact with associated chemical or potable water.
 6. Provide data showing chemical compatibility and history of service with the associated chemical for materials in the system.
 7. Control panel views showing equipment arrangement, doors, equipment layout inside the panel and dimensional information.
 8. Internal interconnecting wiring diagrams showing terminal strips and external devices connected to the panel as specified in Section 40_90_00 - Instrumentation and Controls.
 9. Loop drawings for analog and discrete signals in accordance with ISA 5.4.
 10. Complete schematic and diagrams including terminal block and wire identification numbers and device location symbols consistent with the Contract Documents.
 11. Panel bill of material with detailed description of components and equipment data sheets.
 12. Field cable numbers and terminations.
 13. Manufacturer's Representative's qualifications as specified in Section 01_75_17 - Commissioning.
 14. Manufacturer's certificate stating that the materials of construction are compatible with the pumped fluid.
 15. Manufacturer's Certificate of Source Testing as specified in Section 01_75_17 - Commissioning.
 16. Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01_75_17 - Commissioning.
 17. Capacity control shall be 0 to 100 percent with delivery repeatable within plus or minus 1 percent accuracy over at least an 800 to 1 range.
- D. Calculations: Provide anchorage calculations for each pump skid per Section 01_81_02 - Seismic Design Criteria.
- E. Vendor operation and maintenance manuals: As specified in Section 01_78_24 - Operation and Maintenance Manuals:
1. Provide information on each piece of equipment, including instrumentation.
 2. Provide all safety considerations relating to operations and handling of the associated chemical.
 3. Maintenance data shall include all information and instructions required by plant personnel to keep equipment properly cleaned, lubricated, and adjusted so that it functions economically throughout its full design life.
 4. Lubrication charts and tables of alternate lubricants.
 5. Name, address, and phone number of manufacturer and manufacturer's local service representative.
- F. Commissioning submittals:
1. Provide Certificate of Source Testing as specified in Section 01_75_17 - Commissioning.
 2. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01_75_17 - Commissioning.

1.06 WARRANTY

- A. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds:
1. Manufacturer warranty duration shall be at least 1 year.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Packing, shipping, handling and unloading:
 - 1. Pack for shipping and outdoor storage at the project site for up to 6 months:
 - a. Apply temporary corrosion protective coatings to unpainted components and pack components to protect from the elements.
 - 2. Ship pump and drive completely assembled.

PART 2 PRODUCTS

2.01 GENERAL

- A. A single pump manufacturer shall furnish and coordinate all pump components specified in this Section, including motors, couplings, supports, and other specified accessories and appurtenances to ensure compatibility and integrity of the individual components.
- B. The manufacturer of the pumps shall have sole-source responsibility for furnishing the complete assemblies and meeting the specified performance requirements.

2.02 PUMPS

- A. Equipment:
 - 1. Pump:
 - a. Manufacturers: One of the following or equal:
 - 1) Grundfos, SMART Digital DDA series.
 - 2) Wallace & Tiernan/UGSI Encore series.
 - 2. Type: Simplex chemical proportioning pumps of the positive displacement diaphragm type with variable speed driver and built-in electronic controls.
 - 3. Materials:
 - a. The metering pumps and their components and accessories shall be suitable for the following chemical concentrations, as scheduled in this Section:
 - 1) Sodium Hypochlorite:
 - a) Wetted parts shall be suitable for use with 1 percent sodium hypochlorite solution.
 - b) Other non-specified materials are to be manufacturer's standard for continuous service with 1 percent sodium hypochlorite solution.
 - b. Diaphragm materials:
 - 1) Flat, composite, mechanically actuated diaphragms shall be PTFE faced as pump manufacturer deems suitable for the pumped liquid.
 - c. Other parts in contact with pumped liquid: Suitable for the liquid being pumped.
 - 4. Characteristics:
 - a. Diaphragm simplex chemical proportioning pumps of the positive displacement, flat disc diaphragm type.
 - b. The diaphragm shall be mechanically actuated.
 - c. Diaphragm stroke length shall be constant or adjustable:
 - 1) For constant stroke length: Stroke shall have a fast suction action with a variable discharge stroke speed to control the flow rate.

- 2) For adjustable stroke length:
 - a) Stroke length adjuster shall be 10-turn, micrometer type with stroke indicated in 0.25 percent increments.
 - b) Pump must meet all specified flow criteria at a single stroke length.
- d. Pump shall have automatic degassing function.
- e. Liquid end:
 - 1) Liquid end shall be sealed by means of an o-ring of material compatible with the pumped liquid.
 - 2) Liquid end of each metering pump shall be fitted with a system to detect early stage diaphragm failure. Upon actuation, the leak detector shall stop the pump, light a locally visible LED and trigger a remote alarm.
5. Components:
 - a. Suction and discharge double check valves.
 - b. Built-in internal or external, adjustable pressure relief valve to relieve pressure in the event of discharge line stoppage; which shall be factory set to relieve at 75 pounds per square inch gauge or the maximum pump rated pressure, whichever is lower.
 - c. Hydraulic make-up and air bleed valves.
 - d. Control buttons, knob, and read-out display on front of pump house (control module/cube).
6. Accessories: As indicated in the Drawings, pumps shall be equipped with:
 - a. Calibration column in suction piping.
 - b. Diaphragm backpressure, pulsation dampener, pressure gauges, pressure relief valve, and high-pressure switch in discharge piping.
 - c. Isolation valves.
7. Tests and inspections:
 - a. As scheduled in this Section.

2.03 DRIVE AND MOTOR

- A. Type: Each chemical metering pump shall be motor-driven direct-connected to the pump.
- B. Pump motor shall be a manufacturer standard stepper-motor type, or a direct drive variable speed TEFC motor sized as needed to meet design criteria and as specified in the Electrical sections.
- C. Motor speed shall be controlled locally and remotely.
- D. Drive shall respond automatically to a remote setpoint speed signal (4-20 mA):
 1. The drive shall provide a 4-20 mA speed signal output proportional to armature voltage for remote indication and indicate speed locally on the pump display.
 2. Speed signal output shall be measured independently of the remote setpoint speed signal.
 3. The drive shall also receive a remote start/stop signal and output a general alarm for speed indication and run indication. Locally, the drive must indicate specific alarm causes.
 4. Manufacturer shall furnish required additional components for the drive to function as specified and indicated on the Drawings.

2.04 CONTROLS

- A. Provide chemical metering pump control indicated on the Drawings and as specified in Sections 40_61_15 - Control Strategies.
- B. Each chemical metering pump shall be provided Hand-Off-Automatic (H-O-A) selector switch, rheostat, run-indicator light, and alarm-indicator light. System shall be capable to output position of switch to SCADA:
 - 1. Off: Pump does not run.
 - 2. Auto: Pump is operated based on a signal from the PLC or SCADA with pump speed provided by the PLC or SCADA.
 - 3. Hand: Pump runs and the speed is controlled based on the position of a rheostat, which provides a 4-20 mA signal to the pump.
- C. Pump skid high pressure switch shall provide a hardwired interconnect with the pump and be able to output an alarm to SCADA if triggered.
- D. Provide separate Local Control Panel (LCP) for the chemical feed system. LCP shall include a single non-regulated 120 volt, single phase power source:
 - 1. This power is drawn from the main plant power grid and is not filtered.
 - 2. It is subject to random noise and voltage spikes, and voltage fluctuations of up to plus or minus 15 percent.
 - 3. The manufacturer shall furnish a complete LCP including, but not limited to, the following:
 - a. NEMA Type 4X, FRP, size as required.
 - b. Main circuit breaker.
 - c. Individual circuit breakers for each branch circuit.
 - d. GFCI outlets positioned on the bottom of the panel for pump power.
 - e. Switches, push buttons, pilot lights and indicators as required.
 - f. Contacts for analog and discrete inputs and outputs as indicated in the P&ID drawings and Control Descriptions.
 - g. Instruments, control devices, and other devices as required to perform the operations indicated in the Control Descriptions and indicated on the Drawings.
- E. Locate panel on the pump skid.

2.05 ACCESSORIES

- A. Provide the following materials, or other material as approved by the Engineer:
 - 1. Sodium Hypochlorite:
 - a. Piping: PVC or CPVC.
 - b. Tubing: PFA.
 - c. Valve and Ancillary Equipment: PVC, CPVC.
 - d. Seals: Viton or Teflon (PTFE).
- B. Pulsation dampeners:
 - 1. Manufacturers: One of the following or equal:
 - a. Kemlon Products.
 - b. Blacoh Fluid Controls, Inc.
 - c. Pulsafeeder.
 - d. Primary Fluid Systems, Inc.
 - e. Grifco.

2. Pulsation dampeners shall be furnished and installed on each chemical metering pump's discharge lines as indicated on the Drawings and scheduled in this Section.
 3. Materials:
 - a. Pulsation dampeners materials shall be compatible with the pumped liquid at the specified concentration.
 4. Characteristics:
 - a. Pulsation dampeners shall be gas or air charged, single diaphragm type complete with valved gas/air charge valve connection and pressure gauge graduated from 0 to 200 pounds per square inch.
 - b. Pulsation dampeners shall allow no more than 6 percent discharge pressure fluctuation.
 5. Dampeners shall be provided with a true-union ball valve for shutoff.
- C. Calibration columns:
1. Materials:
 - a. Materials shall be compatible with the pumped liquid and concentration specified in this Section.
 2. Characteristics:
 - a. Furnish and install calibration columns, 1 for each skid, on each chemical pump's inlet line as indicated on the Drawings and specified in this Section:
 - 1) Columns shall be translucent.
 - b. Provide top cap threaded connection with vent piped to common vent piping to prevent entry of foreign materials and to direct spillage or overflow.
 - c. End connections shall be flanged.
 - d. Capacities and graduations shall be as recommended by column manufacturer and large enough to accommodate the autocalibration feature of the pump.
- D. Diaphragm backpressure and pressure relief valves:
1. Manufacturers: One of the following or equal:
 - a. Pulsafeeder.
 - b. Griffco.
 - c. Milton Roy Co.
 - d. Primary Fluid Systems, Inc.
 2. Materials:
 - a. Valves shall be of suitable materials for the pumped liquid.
 3. Characteristics:
 - a. Ported to serve as either a backpressure valve or a pressure relief valve.
 - b. Relief valve shall be plumbed to the nearest chemical drain, or back to the pump suction on the non-pump side of the pump suction isolation valve, to avoid spillage, as indicated on the Drawings.
 - c. Valves shall be furnished and installed on each chemical metering pump's discharge lines as indicated on the Drawings and scheduled in this Section, including the valve at the injection locations.
 - d. Valves shall have an adjustable spring range of 15-100 pounds per square inch. Valves shall be factory adjusted for the backpressure recommended by the pump manufacturer.

- e. Valves shall produce a back pressure no greater than 10 pounds per square inch above valve set pressure when metering pumps are operating at full capacity, pulsating flow.
 - f. Supplier shall provide 2 additional backpressure valves to be installed by the Contractor at the water storage reservoirs:
 - 1) Remote backpressure valves shall be set 5-10 psi higher than skid backpressure valves.
- E. Diaphragm seals:
- 1. One of the following or equal:
 - a. Primary Fluids Systems.
 - 2. Materials:
 - a. Body: See section 2.05.A.
 - b. Diaphragm: PTFE.
 - c. Pressure: Rated to 200 psi.
- F. Pressure gauges:
- 1. One of the following or equal:
 - a. Primary Fluids Systems.
 - 2. Materials:
 - a. Premium Series, 2.5 inch diameter, liquid filled.
 - b. Connection Size: 1/4 inch.
 - c. Housing: Stainless steel.
 - d. Internals: 316 stainless steel.
 - e. Accuracy: +/- 1.6 percent or less.
 - f. Pressure Range: See Pump Skid Schedule.
- G. Pressure switch:
- 1. One of the following or equal:
 - a. Plast-O-Matic Series SWT.
 - 2. Materials:
 - a. Corrosion resistant for chemical service applications.
 - b. Pressure: Rated for 150 psi.
 - c. Enclosure: NEMA 4X rates.
 - d. Wetted Materials: See section 2.05.A.
 - e. Diaphragm: PTFE.
 - f. Pressure Setpoint: See Pump Skid Schedule.
- H. Additional accessories:
- 1. Additional accessories required for the system but not required to be supplied by the pump manufacturer include:
 - a. Pump and equipment mounting skid:
 - 1) Pump skids shall house 3 pumps with all valves, calibration column, control panel, and appurtenances needed for operating the chemical pumps as indicated in the Drawings.
 - 2) Pump skid shall be constructed of polyethylene or polypropylene.
 - 3) See drawings for maximum skid dimensions.
 - 4) A drip pan and drain shall be integrated into the skid with 1-inch bulkhead fitting.

- 5) Skid shall be plumbed with pipe and fittings type as scheduled in this Section and as shown on the Drawings:
 - a) Pipe and appurtenances shall be mounted to the skid using click-in type non-metallic pipe supports.
- 6) All skids shall be fully assembled and tested prior to delivery:
 - a) The piping, ancillary equipment, and appurtenances for the existing pumps' skid shall be tested prior to delivery.
 - b. Isolation valves as specified in Section 40_05_63 - Ball Valves for suction and discharge piping as indicated on the Drawings.
 - c. Check valves as specified in Section 40_05_65.24 - Check Valves for discharge piping as indicated on the Drawings.
 - d. Piping as specified in Section 40_05_31.01 - Plastic Piping and Tubing.
 - e. Each skid pump will have a discharge high pressure switch interlocked to the skid VCP and set as scheduled to shut down the pump.

2.06 NAMEPLATES

- A. Each pump and motor shall have, securely affixed in a conspicuous location, a stainless-steel nameplate with raised letters providing the manufacturer's model, serial number, rating, range, speed and other pertinent data.

2.07 SPARE PARTS AND SPECIAL TOOLS

- A. Spare parts: Furnish the following spare parts packed and labeled for warehouse storage:
 1. Complete set of inlet and outlet ball check valves (balls, seats and gaskets) and a diaphragm for each pump.
 2. 1 complete spare parts kit for each pump provided.
 3. 1 spare parts kit for each size and type of backpressure and pressure relief valve.
 4. An initial supply of all oils, greases, and lubricants required to start operations. Supply an amount of these materials equivalent to 1 year of continuous operation for each system.
- B. Special tools: Deliver 1 set for each furnished pump type and size needed to assemble and disassemble pump system.

PART 3 EXECUTION

3.01 COMMISSIONING

- A. As specified in Section 01_75_17 - Commissioning and this Section.
- B. Manufacturer services:
 1. Provide certificates:
 - a. Manufacturer's Certificate of Source Testing.
 - b. Manufacturer's Certificate of Installation and Functionality Compliance.
 2. Manufacturer's Representative onsite requirements:
 - a. Installation review and functional Testing: 2 trips, 3 day minimum each.
 3. Training:
 - a. Maintenance: 4 hours per session, 2 sessions.
 - b. Operation: 2 hours per session, 2 sessions.

4. Process operational period:
 - a. As required by Owner or Contractor.

C. Source testing: As specified in Pump Schedule.

D. Functional testing: As specified in Pump Schedule.

3.02 SCHEDULES

A. Pump Skids:

Tag Number	CFP-3301, CFP-3302, CFP-3303
Feed Point	As indicated in the Drawings
Service	Sodium Hypochlorite
Pump Type	Single Diaphragm
Total Number of Pumps	3
Named Manufacturer	Grundfos
Named Manufacturer Model Number	DDA 120-7
Number of Pump Skids	1
Number of Pumps per Skid	3
Maximum Flow, (gallons per hour)	30
Minimum Flow, (gallons per hour)	0.5
Normal Flow, (gallons per hour)	8.8
Pump Stroke Range (strokes per minute)	By Manufacturer
Maximum Discharge Pressure (psig)	100
Minimum Suction Lift (feet)	3
Backpressure Valve Setting/ Remote Backpressure Valve Setting (psig)	65/75
Relief Valve Setting (psig)	90
High Pressure Switch Setting (psig)	85
Pump Housing/Enclosure	PVC (with Kynar head)
Pump Diaphragm	Full PTFE
Pump Connections	Tube Compression Fitting
Elastomers/Seals	FKM (Viton™)
Pipe Material	PVC
Driver Type	Stepper Motor
Voltage/Phases/Hertz	120/1/60

Tag Number	CFP-3301, CFP-3302, CFP-3303
NEMA Enclosure Type	4X
Test Witnessing	Not Witnessed
Performance Test Level	1
Vibration Test Level	None
Noise Test Level	None
Performance Test Level	1
Vibration Test Level	None
Noise Test Level	None

END OF SECTION

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SECTION 43_41_43
POLYETHYLENE TANKS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Type 1 and Type 2 polyethylene storage tanks. Type 1 tank shall be made from crosslinked polyethylene resin and Type 2 shall be made from linear (non-crosslinked) polyethylene resin.

1.02 REFERENCES

- A. American Society for Mechanical Engineers (ASME):
1. B16.4 - Gray Iron Threaded Fittings.
 2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.
- B. ASTM International (ASTM):
1. D638 - Standard Test Method for Tensile Properties of Plastics.
 2. D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 3. D1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique.
 4. D1525 - Standard Test Method for Vicat Softening Temperature of Plastics.
 5. D1693 - Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
 6. D1998 - Standard Specification for Polyethylene Upright Storage Tanks.
 7. D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
- C. National Fire Protection Association (NFPA):
1. 30 - Flammable and Combustible Liquid Code.
- D. National Electrical Manufacturer's Association (NEMA).
- E. Occupational Safety and Health Administration (OSHA):
1. 29 CFR Part 1910 - Occupational Safety and Health Standards.

1.03 DESIGN CRITERIA

- A. Tanks: As scheduled.
- B. Tank wall thickness: Calculated in accordance with ASTM D1998 using design specific gravity as scheduled. Note that design specific gravity may be higher than specific gravity of tank contents.

- C. Design requirements:
1. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation, but shall not be less than 0.187 inches thick:
 - $T = P \times O.D./2 SD = 0.433 \times S.G. \times H \times O.D./2 SD$
 - T = wall thickness, in.
 - SD = hydrostatic design stress, psi
 - P = pressure (.433 x S.G. x H), psi
 - H = fluid head, ft.
 - S.G. = specific gravity, g/cm³
 - O.D. = outside diameter, in.
- D. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application:
1. The hydrostatic design stress is 600 pounds per square inch at 73 degrees Fahrenheit for Type I and Type II materials.
 2. The tank shall have a stratiform (tapered wall thickness) wall.
- E. The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.
- F. The minimum design specific gravity shall be 1.5.
- G. The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support:
1. Flat areas shall be provided to allow locating large fittings on the cylinder straight shell.
- H. The top head must be integrally molded with the cylinder shell:
1. The minimum thickness of the top head shall be equal to the top of the straight wall.
- I. The tank shall be designed to provide a minimum of 4 tie-down lugs integrally molded into the top head:
1. The tie-down lugs shall be designed to allow tank retention in seismic loading situations without tank damage.
- J. Tank shell thickness:
1. In accordance with ASTM D1998, Section 6.1.
 2. Design tank wall thickness for liquid with specific gravity as specified.
 3. Provide adequate thickness at all fittings and connection points for mounting of fittings to the tank without damage to the tank or causing excessive deflection.
 4. Maximum allowable hoop stress used in tank wall thickness calculations per ASTM D1998 shall be based on test data in accordance with ASTM D2837.
- K. Seismic restraint system:
1. Seismic design criteria: As specified in Section 01_81_02 - Seismic Design Criteria.
 2. Consist of Type 316 stainless steel angles or brackets equally spaced around the tank perimeter anchored into the concrete tie down cable.

3. If the restraint system includes the use of tensioning and adjustment devices, such as turnbuckles, provide easy adjustment of the cables at the time of construction and as required in the future:
 - a. Hardware shall be provided to attach cables to anchored brackets at the base of the tank.
4. The tank shall be designed to provide a minimum of 4 tie-down lugs integrally molded into the top head:
 - a. The tie-down lugs shall be designed to allow tank retention in seismic loading situations without tank damage.
 - b. Anchor bolts shall be provided by the Contractor per the instructions and the base plates for the system.

1.04 SUBMITTALS

- A. Fabrication drawings for each tank including:
 1. Dimensions.
 2. Tank wall thickness.
 3. Materials of construction.
 4. Tank fittings.
 5. Tank appurtenances.
 6. Tank restraint system.
 7. Tank resin and hoop stress data.
- B. Chemical compatibility sheet to include:
 1. Chemical to be stored.
 2. Percentage of chemical.
 3. Temperature of chemical.
- C. Engineering design calculations of restraint and anchoring system signed by a civil or structural engineer registered in the state where the project is located.
- D. Installation instructions.
- E. Warranty.
- F. Certification to certify that each tank is suitable for the specified chemical service, no degradation within warranty period, including tank fittings and gasket material.
- G. Proof of qualification: Provide lists of installation and contact information with same type of application and chemical used.
- H. Color charts for proposed coating systems.

1.05 WARRANTY

- A. Manufacturer warranty against defects:
 1. Tank: 5 years full warranty. Prorated warranties are not acceptable.

1.06 QUALITY ASSURANCE

- A. Qualification of manufacturer: Manufacturer with experienced personnel, physical facilities, and management capacity sufficient to produce custom-made rotationally

molded polyethylene tanks of the size, exposure, and chemical services specified for minimum 5 years with satisfactory performance record.

PART 2 PRODUCTS

2.01 SCOPE OF SUPPLIES

- A. Provide all materials, labor, equipment, and hardware to provide all polyethylene storage tanks with specified fittings and accessories, seismic load restraint systems, anchor bolts, and flange flexible connectors for complete installation in the positions and orientations indicated on the Drawings.

2.02 MANUFACTURERS

- A. One of the following or equal:
 - 1. Poly Processing Co.
 - 2. Snyder Industries, Inc.
 - 3. Assmann Corp.

2.03 TANK MATERIALS

- A. Type 1 high-density crosslinked polyethylene (XLPE) or Type 2 high-density linear polyethylene (HDLPE).
- B. Resin:
 - 1. Manufacturers: One of the following or equal:
 - a. PAXON, grade 7204 resin for crosslinkable polyethylene.
 - b. Exxon, 8660-8661 for linear polyethylene.
- C. The material used shall be virgin polyethylene resin as compounded and certified by the manufacturer:
 - 1. Type 1 tanks shall be made from crosslinked polyethylene resin as manufactured by ExxonMobil Chemical, or resin of equal physical and chemical properties.
 - 2. Type II tanks shall be made from high-density linear polyethylene resin as manufactured by ExxonMobil Chemical, or resin of equal physical and chemical properties.
 - 3. Resin choice would be based on the specific application, chemical to be stored and concentration.
- D. Ultraviolet stabilizer:
 - 1. The polyethylene resin material shall contain a minimum of a UV 8 stabilizer as compounded by the resin manufacturer.
 - 2. Pigments may be added but shall not exceed 0.25 percent (dry blended) of the total weight.
- E. Free of holes, blisters, crazing, cracking, delamination, undispersed raw materials, and any sign of contamination from foreign matter:
 - 1. The finished tank wall shall be free of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking, and delaminations.
 - 2. All cut edges where openings are cut into the tanks shall be trimmed smooth.

F. Resin shall meet or exceed the following properties:

1. Mechanical Properties of Type 1 of Tank Material: Current XLPE Resin:

Property	ASTM	Value
Density (Resin)	D1505	0.938-0.946 g/cc
Tensile (Yield Stress 2"/min)	D638	3,000 psi
Elongation at Break (2"/min.)	D638	>300%
ESCR (100% Igepal, Cond. A, F50)	D1693	>1000 hours
ESCR (10% Igepal, Cond. A, F50)	D1693	>1000 hours
Vicat Softening Temperature,	D1525	250
Flexural Modulus	D790	100,000 psi

2. Mechanical Properties of Type II tank material: Current HDLPE Resin:

Property	ASTM	Value
Density (Resin)	D1505	0.942-0.948 g/cc
Tensile (Yield Stress 2"/min)	D638	2,950 psi
Elongation at Break (2"/min.)	D638	>1,000%
ESCR (100% Igepal, Cond. A, F50)	D1693	550 hours
ESCR (10% Igepal, Cond. A, F50)	D1693	48 hours
Vicat Softening Temperature	D1525	235
Flexural Modulus	D790	129,000 psi

G. Gel test: This test does not apply to Type II linear resins:

1. Inner portion of tank wall:
 - a. Not less than 65 percent.
 - b. ASTM D1998 requirements.
2. Entire wall thickness: Not less than 80 percent.

H. Restraint system:

1. Metal components, including anchor bolts:
 - a. Type 304 stainless steel.
 - b. The Anchor bolts shall be supplied by the tank manufacturer.
 - c. The drawings and calculations for the seismic system shall be submitted for review.
2. Concrete anchors or flush shells shall not be used.

2.04 FITTINGS

- A. Terminate in socket, threaded, or flanged connections:
 - 1. Flanges: 150 pound ASME B 16.5.
 - 2. Double flanged CPVC bolted fittings with encapsulated stainless steel or Hastelloy bolts.
 - 3. Threaded connections: ASME B 16.4.

- B. Fittings at upper tank sidewall or top:
 - 1. Compression threaded type, long shank, polyvinyl chloride flanged fittings with deep cut threads (not injection molded thread) and with dual wide nuts.
 - 2. The bulkhead fittings shall be constructed of PVC, PP, or other specified material.
 - 3. Gaskets shall be a minimum of 1/4 inch thickness and constructed of 60-70 durometer Viton™ or other specified material.

- C. Fittings on tank top:
 - 1. Bosses molded into the tank.
 - 2. Fittings shall be vertical.
 - 3. The top head shall be integrally molded with the cylinder shell.
 - 4. The minimum thickness of the top head shall be equal to the top of the straight wall.

- D. Flanged outlet drain fitting in the lower tank sidewall: Integrally molded into the bottom knuckle of the tank to allow full drainage of tank contents.

- E. Fittings and appurtenances for each tank:
 - 1. One minimum flanged inlet nozzle entering the tank in the top near the wall, as scheduled.
 - 2. One minimum flanged outlet/drain nozzle, integrally molded with tank wall.
 - 3. One flanged overflow nozzle on tank wall.
 - 4. One flanged tank level float on tank wall, as scheduled.
 - 5. One flanged roof nozzle for blower/vent connection, as scheduled.
 - 6. One flanged roof nozzle for mounting of tank level sensor.
 - 7. One flanged roof vent, as scheduled.
 - 8. One flanged type or molded screw type manway lid on top of the tank, as scheduled:
 - a. Manway shall be sealed and shall be constructed of the same material as tank.
 - b. The bolts shall be stainless steel.
 - c. The gaskets shall be per tank manufacturer recommendation for the chemical stored.

2.05 ACCESSORIES

- A. Tank vents:
 - 1. Each tank shall be properly vented for the type of material and flow rates expected.
 - 2. Vents must comply with OSHA Part 1910 normal venting for atmospheric tanks or other accepted standard or shall be as large as the filling or withdrawal connection, whichever is larger but in no case less than 2 inches nominal inside diameter with screening.

3. Sodium hypochlorite tanks will have active ventilation while the tank is filled to dilute hydrogen gas created during the hypochlorite generation process. Hydrogen gas must be diluted and expelled to prevent explosion or fires.
- B. Sodium hypochlorite tank overflow shall have u-bend trap prevent release of hydrogen and chlorine gases with active ventilation.
- C. Brine tank cover:
 1. Provide a hinged tank cover that opens half the top area for salt loading access for the brine storage tank.

2.06 TANK FABRICATION

- A. Rotationally molded construction in accordance with ASTM D1998.
- B. Provide for each tank the following shop finishing:
 1. Shipping label identifying:
 - a. Tank tag number.
 - b. Chemical service.
 2. Permanent labels:
 - a. Identification label.
 - b. NFPA label specifically coded for the tank contents in accordance with NFPA 30.
 - c. Paint or affix label onto the tank wall to be clearly visible from outside the tank enclosure.

2.07 TESTING

- A. Each tank shall be leak tested by the manufacturer prior to shipment by filling with clean water for a period of at least 4 hours with all fittings installed and blinded:
 1. There shall be no measurable drop in liquid surface.
 2. Any leaks shall be noted, repaired, and the tank shall be re-tested for an additional 4 hours minimum:
 - a. Reason for leak and method of repair shall be recorded and submitted to the Engineer.
 3. Any defects or leaks that have not been adequately repaired will be cause for rejection of the tank.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 1. Transportation, handling, storage of the tanks, and installation shall be in accordance with the manufacturer's printed instructions.
 2. Repair any damage to tank components or the insulation due to transportation or installation.
 3. Install piping to tank with sufficient flexibility to allow tank movement of 1 inch in any direction without damage to piping.

- B. All tank fitting attachments shall be equipped with flexible couplers or other movement provisions provided by the tank customer:
1. The tank will deflect based upon tank loading, chemical temperature and storage time duration.
 2. Tank piping flexible couplers shall be designed to allow 4 percent design movement.
 3. Movement shall be considered to occur both outward in tank radius and downward in fitting elevation from the neutral tank fitting placement.

3.02 FIELD QUALITY CONTROL

- A. Manufacturer's field service:
1. Inspect the installed tanks for proper installation.
 2. Instruct Owner's personnel on operations and maintenance of the tanks.

3.03 SCHEDULE

- A. Tank schedule as follows:

Tag Number	TNK-3201, TNK-3202	TNK-3102
Service	Sodium Hypochlorite at 0.7% solution	Brine Solution
Chemical pH	> 9.5	5.0 - 8.0
Chemical Specific Gravity	1.02	> 1.02
Tank Design Specific Gravity	1.5	1.5
Number of Tanks	2	1
Usable Capacity, each	500 gal	400 gal
Type of Tank	Linear HDPE or Cross-Link Polyethylene	Linear HDPE or Cross-Link Polyethylene
General Design	Flat bottom, dished top	Flat bottom, flat top
Installation	Vertical	Vertical
Diameter	4'-0"	4'-8"
Height	7'-0" (max)	4'-0" (max)
Inlet Nozzle Size (inches)	1	1/2
Outlet Nozzle Size (inches)	1	1/2
Drain Nozzle Size (inches)	1	1

Tag Number	TNK-3201, TNK-3202	TNK-3102
Overflow Nozzle Size (inches)	2	1
Vent Nozzle Size (inches)	2	2
Blower Connection Nozzle Size (inches)	2	Not Required
Float Level Nozzle Size (inches)	2	Not Required
Roof Nozzle Size (inches)	2-inch nozzle for mounting ultrasonic level sensor	2-inch nozzle for mounting level sensor
Top Manway (inches)	16	N/A
Ladder	Not Required	Not Required
Lifting Lugs	Required	Not Required
Level Indicator	Not Required	Not Required
Pipe and Conduit Supports	Required	Required

END OF SECTION

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SECTION 46_05_10

COMMON WORK RESULTS FOR MECHANICAL EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Basic design and performance requirements for building mechanical equipment and process mechanical equipment.

1.02 REFERENCES

- A. American Gear Manufacturer's Association (AGMA) Standards:
 - 1. 6001-E08 - Design and Selection of Components for Enclosed Gear Drives.
- B. American Bearing Manufacturers Association (ABMA) Standards:
 - 1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 2. 11 - Load Ratings and Fatigue Life for Roller Bearings.
- C. American Petroleum Institute (API):
 - 1. 682 - Shaft Sealing Systems for Centrifugal and Rotary Pumps.
- D. ASTM International (ASTM):
 - 1. A36 - Standard Specification for Carbon Structural Steel.
 - 2. A48 - Standard Specification for Gray Iron Castings.
 - 3. A125 - Standard Specification for Steel Springs, Helical, Heat-Treated.
 - 4. A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - 5. A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - 6. A320 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
 - 7. A536 - Standard Specification for Ductile Iron Castings.
 - 8. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 9. B61 - Standard Specification for Steam or Valve Bronze Castings.
 - 10. B62 - Standard specification for Composition Bronze or Ounce Metal Castings.
 - 11. B505 - Standard Specification for Copper Alloy Continuous Castings.
 - 12. B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
 - 13. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - 14. F594 - Standard Specification for Stainless Steel Nuts.
- E. Hydraulic Institute (HI).
- F. Occupational Safety and Health Administration (OSHA).
- G. Unified Numbering System (UNS).

1.03 DEFINITIONS

- A. Resonant frequency: That frequency at which a small driving force produces an ever-larger vibration if no dampening exists.
- B. Rotational frequency: The revolutions per unit of time usually expressed as revolutions per minute.
- C. Critical frequency: Same as resonant frequency for the rotating elements or the installed machine and base.
- D. Peak vibration velocity: The root mean square average of the peak velocity of the vibrational movement times the square root of 2 in inches per second.
- E. Rotational speed: Same as rotational frequency.
- F. Maximum excitation frequency: The excitation frequency with the highest vibration velocity of several excitation frequencies that are a function of the design of a particular machine.
- G. Critical speed: Same as critical frequency.
- H. Free field noise level: Noise measured without any reflective surfaces (an idealized situation); sound pressure levels at 3 feet from the source unless specified otherwise.
- I. Operating weight: The weight of unit plus weight of fluids or solids normally contained in unit during operation.

1.04 DESIGN REQUIREMENTS

- A. General:
 - 1. Product requirements as specified in Section 01_60_00 - Product Requirements.
 - 2. Project conditions as specified in Section 01_81_01 - Project Design Criteria.
 - 3. Provisions specified under each technical equipment specification prevail over and supersede conflicting provisions specified in this Section.
 - 4. Equipment manufacturer's responsibility extends to selection and mounting of gear drive units, motors or other prime movers, accessories, and auxiliaries required for proper operation.
 - 5. Vibration considerations:
 - a. Resonant frequency:
 - 1) For single-speed equipment, ensure there are no natural resonant frequencies within 25 percent above or below the operating rotational frequencies or multiples of the operating rotational frequencies that may be excited by the equipment design.
 - 2) For variable-speed equipment, ensure there are no natural resonant frequencies within 25 percent above or below the range of operating frequencies.
 - b. Design, balance, and align equipment to meet the vibration criteria specified in Section 46_05_94 - Mechanical Equipment Testing.
 - 6. Equipment units weighing 50 pounds or more: Provide with lifting lugs or eyes to allow removal with hoist or other lifting device.

- B. Power transmission systems:
1. V-belts, sheaves, shaft couplings, chains, sprockets, mechanical variable-speed drives, variable frequency drives, gear reducers, open and enclosed gearing, clutches, brakes, intermediate shafting, intermediate bearings, and U-joints are to be rated for 24 hour-a-day continuous service or frequent stops-and-starts intermittent service, whichever is most severe, and sized with a service factor of 1.5 or greater in accordance with manufacturer recommendations:
 - a. Apply service factor to nameplate horsepower and torque of prime source of power and not to actual equipment loading.
 - b. Apply service factors in accordance with AGMA 6001-E08, other applicable AGMA standards, or other applicable referenced standards.
- C. Equipment mounting and anchoring:
1. Mount equipment on cast-iron or welded-steel bases with structural steel support frames:
 - a. Utilize continuous welds to seal seams and contact edges between steel members.
 - b. Grind welds smooth.
 2. Provide bases and supports with machined support pads, dowels for alignment of mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits.
 3. Provide jacking screws in bases and supports for equipment weighing over 1,000 pounds.
 4. Design equipment anchorage, supports, and connections for dead load, running loads, loads during start-up, seismic load specified in Section 01_81_02 - Seismic Design Criteria, and other loads as required for proper operation of equipment:
 - a. For equipment with an operating weight of 400 pounds or greater and all equipment that is supported higher than 4 feet above the floor, provide calculations for:
 - 1) The operating weight and location of the centroid of mass for the equipment.
 - 2) Forces and overturning moments.
 - 3) Shear and tension forces in equipment anchorages, supports, and connections.
 - 4) The design of equipment anchorage, supports, and connections based on calculated shear and tension forces.
 - 5) Calculations shall be sealed by a Professional Structural Engineer registered in the State of Washington.
 5. Anchorage of equipment to concrete or masonry:
 - a. Perform calculations and determine number, size, type, strength, and location of anchor bolts or other connections.
 - b. Provide bolt sleeves around cast-in anchor bolts for 400 pounds or greater equipment:
 - 1) Adjust bolts to final location and secure the sleeve.
 6. Anchorage of equipment to metal supports:
 - a. Perform calculations and determine number, size, type, strength, and location of bolts used to connect equipment to metal supports.
 7. Unless otherwise indicated on the Drawings, install equipment supported on concrete over non-shrink grout pads as specified in this Section.

1.05 SUBMITTALS

- A. As specified in Section 01_60_00 - Product Requirements.
- B. Product data:
 - 1. For each item of equipment:
 - a. Design features.
 - b. Load capacities.
 - c. Efficiency ratings.
 - d. Material designations by UNS alloy number or ASTM Specification and Grade.
 - e. Data needed to verify compliance with the Specifications.
 - f. Catalog data.
 - g. Nameplate data.
 - h. Clearly mark submittal information to show specific items, materials, and accessories or options being furnished.
 - 2. Gear reduction units:
 - a. Engineering information in accordance with applicable AGMA standards.
 - b. Gear mesh frequencies.
- C. Shop drawings:
 - 1. Drawings for equipment:
 - a. Drawings that include cut-away drawings, parts lists, material specification lists, and other information required to substantiate that proposed equipment complies with specified requirements.
 - 2. Outline drawings showing equipment, driver, driven equipment, pumps, seal, motor(s) or other specified drivers, variable frequency drive, shafting, U-joints, couplings, drive arrangement, gears, base plate or support dimensions, anchor bolt sizes and locations, bearings, and other furnished components.
 - 3. Installation instructions including leveling and alignment tolerances, grouting, lubrication requirements, and initial Installation Testing procedures.
 - 4. Wiring, control schematics, control logic diagrams and ladder logic or similar for computer-based controls.
 - 5. Recommended or normal operating parameters such as temperatures and pressures.
 - 6. Alarm and shutdown setpoints for all controls furnished.
- D. Calculations:
 - 1. Structural:
 - a. Substantiate equipment base plates, supports, bolts, anchor bolts, and other connections meet minimum design requirements specified and seismic design criteria as specified in Section 01_81_02 - Seismic Design Criteria.
 - 2. Mechanical:
 - a. ABMA 9 or ABMA 11 L10 life for bearings calculation methods for drivers, pumps, gears, shafts, motors, and other driveline components with bearings.
 - b. Substantiate that operating rotational frequencies meet the requirements of this Section.

- c. Torsional analysis of power transmission systems: When torsional analysis specified in the equipment sections, provide:
 - 1) Sketch of system components identifying physical characteristics including mass, diameter, thickness, and stiffness.
 - 2) Results of analysis including first and second critical frequencies of system components and complete system.
- d. Calculations shall be signed and stamped by a licensed engineer.
- 3. Drinking water:
 - a. If applicable, conform to the requirements of Section 01_60_00 - Product Requirements for materials in contact with drinking water.
- E. Operation and maintenance manuals:
 - 1. As specified in Section 01_78_24 - Operating and Maintenance Manuals.
 - 2. Equipment with bearings:
 - a. Include manufacturer and model number of every bearing.
 - b. Include calculated ball pass frequencies of the installed equipment for both the inner and outer raceways.
- F. Commissioning submittals: As specified in Section 01_75_17 - Commissioning.
- G. Project closeout documents: As specified in Section 01_77_00 - Closeout Procedures.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials as specified in Section 01_60_00 - Product Requirements including special requirements for materials in contact with drinking water.
- B. Ferrous materials:
 - 1. Steel for members used in fabrication of assemblies: ASTM A36.
 - 2. Iron castings: ASTM A48, tough, close-grained gray iron, free from blowholes, flaws, and other imperfections.
 - 3. Ductile iron castings: ASTM A536, Grade 65-45-12, free from flaws and imperfections.
 - 4. Galvanized steel sheet: ASTM A653, minimum 0.0635-inch (16-gauge).
 - 5. Expanded metal: ASTM A36, 13-gauge, 1/2-inch flat pattern expanded metal.
 - 6. Stainless steel:
 - a. As specified in Section 05_12_00 - Structural Steel.
 - b. In contact or within 36 inches of water: Type 316 or 316L.
 - c. In sea air environment: Type 316 or 316L.
 - d. Other locations: Type 304 or 304L.
 - e. Source cleaning and passivation as specified in Section 05_12_00 - Structural Steel.
- C. Non-ferrous materials:
 - 1. Bronze in contact with drinking water: Composition of not more than 2 percent aluminum nor more than 6 percent zinc; UNS Alloy C89833, C89520, or C92200 in accordance with ASTM B61, B62, B505, or B584, when not specified otherwise.

2. Bronze in contact with wastewater: Composition of not more than 2 percent aluminum nor more than 6 percent zinc; UNS Alloy C83600, C89833, C89520, C92200, or C93700 in accordance with ASTM B61, B62, B505, or B584, when not specified otherwise.
- D. Dielectric materials for separation of dissimilar metals:
1. Neoprene, bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other materials as specified.
- E. Non-shrink grout and epoxy non-shrink grout: As specified in Section 03_60_00 - Grouting.

2.02 ANCHORS AND FASTENERS

- A. Mechanical anchoring to concrete and masonry:
1. Type 316 stainless steel.
 2. Design as specified in Section 01_81_02 - Seismic Design Criteria.
- B. High-strength fasteners:
1. As specified in Section 05_12_00 - Structural Steel.
- C. Flange bolts:
1. As specified in Section 33_05_00.01 - Common Work Results for General Piping.
- D. Mechanical assembly fasteners:
1. Stainless steel:
 - a. Low-temperature service:
 - 1) Bolts: ASTM A320, Grade B8 (Type 304) or Grade B8M (Type 316), Class 1, heavy hex.
 - 2) Nuts: ASTM A194, Grade 8 (Type 304) or Grade B8M (Type 316), heavy hex.
 - 3) Washers: Alloy group matching bolts and nuts.
 - b. General service:
 - 1) Bolts: ASTM F593, Alloy Group 1 (Type 304) or Alloy Group 2 (Type 316).
 - 2) Nuts: ASTM F594, Alloy Group 1 (Type 304) or Alloy Group 2 (Type 316).
 - 3) Washers: Alloy group matching bolts and nuts.

2.03 VENDOR CONTROL PANELS

- A. As specified in the individual equipment Sections and Section 40_90_00 - Instrumentation and Controls.

2.04 EQUIPMENT SUPPORT FRAMES

- A. Bolt holes shall not exceed bolt diameter by more than 25 percent, up to a limiting maximum diameter oversize of 1/4-inch.

2.05 PIPING AND VALVES

- A. Piping as specified in Section 33_05_00.01 - Common Work Results for General Piping.
- B. Valves as specified in Section 40_05_51.01 - Common Work Results for Valves.

2.06 SAFETY EQUIPMENT

- A. Safety guards:
 - 1. Provide guards that protect personnel from rotating shafts or components within 7.5 feet of floors or operating platforms.
 - 2. Requirements:
 - a. Allow visual inspection of moving parts without removal.
 - b. Allow access to lubrication fittings.
 - c. Prevent entrance of rain or dripping water for outdoor locations.
 - d. Size belt and sheave guards to allow for installation of sheaves 15 percent larger and addition of 1 belt.
 - 3. Materials:
 - a. Sheet metal: Carbon steel, 12-gauge minimum thickness, hot-dip galvanized after fabrication.
 - b. Fasteners: Type 304 stainless steel.
- B. Insulation:
 - 1. Insulate all surfaces with normal operating temperatures above 120 degrees Fahrenheit when surface is within 7.5 feet height from any operating floor or level.
 - 2. Insulation thickness such that temperature is below 120 degrees Fahrenheit.
 - 3. Insulation Type 3 and cover Type 5 as specified in Section 40_05_06.55 - Piping Insulation.
- C. Warning signs:
 - 1. Provide warning signs in accordance with OSHA requirements for equipment that starts automatically or remotely.
 - 2. Material, sign size, and text: As specified in Section 10_14_00 - Signage.
 - 3. Mount warning signs with stainless steel fasteners at equipment.

2.07 NAMEPLATES

- A. Fastened to equipment at factory in an accessible and visible location.
- B. Stainless steel sheet engraved or stamped with text, holes drilled or punched for fasteners.
- C. Fasteners: Number 4 or larger oval head stainless steel screws or drive pins.
- D. Text:
 - 1. Manufacturer's name, equipment model number and serial number, motor horsepower when appropriate, and identification tag number.
 - 2. Indicate the following additional information as applicable:
 - a. Maximum and normal rotating speed.
 - b. Service class per applicable standards.

3. Include for pumps:
 - a. Rated total dynamic head in feet of fluid.
 - b. Rated flow in gallons per minute.
 - c. Impeller, gear, screw, diaphragm, or piston size.
4. Include for gear reduction units:
 - a. AGMA class of service.
 - b. Service factor.
 - c. Input and output speeds.

2.08 SHOP FINISHES

- A. Provide appropriate factory coatings as specified in Section 09_96_01 - High-Performance Coatings.

2.09 SPECIAL TOOLS

- A. Supply 1 set of special tools as specified in Section 01_60_00 - Product Requirements.

2.10 SOURCE TESTING

- A. Testing requirements unless specified otherwise in the individual equipment specifications:
 1. Mechanical equipment: Level 1 General Equipment Performance Test as specified in Section 46_05_94 - Mechanical Equipment Testing.
 2. Vendor control panels: As specified in Section 40_90_00 - Instrumentation and Controls.

2.11 SHIPPING

- A. As specified in Section 01_60_00 - Product Requirements.
- B. Prior to shipment of equipment:
 1. Fasteners:
 - a. Inspect for proper torques and tightness.

PART 3 EXECUTION

3.01 DELIVERY, HANDLING, STORAGE, AND PROTECTION

- A. As specified in Section 01_60_00 - Product Requirements.
- B. Inspect fasteners for proper torques and tightness.
- C. Protection:
 1. Equipment Log shall include description of rotation performed as part of maintenance activities.

3.02 INSTALLATION

- A. Field measurements:
 - 1. Prior to shop drawings preparation, take measurements and verify dimensions indicated on the Drawings.
 - 2. Ensure equipment and ancillary appurtenances fit within available space.
- B. Sequencing and scheduling:
 - 1. Equipment anchoring: Obtain anchoring material and templates or setting drawings from equipment manufacturers in adequate time for anchors to be cast-in-place.
 - 2. Coordinate details of equipment with other related parts of the Work, including verification that structures, piping, wiring, and equipment components are compatible.
- C. Metal work embedded in concrete:
 - 1. Accurately place and hold in correct position while concrete is being placed.
 - 2. Clean surface of metal in contact with concrete immediately before concrete is placed.
- D. Concrete surfaces designated to receive non-shrink grout:
 - 1. Heavy sandblast concrete surface in contact with non-shrink grout.
 - 2. Clean concrete surfaces of sandblasting sand, grease, oil, dirt, and other foreign material that may reduce bond to non-shrink grout.
 - 3. Saturate concrete with water. Concrete shall be saturated surface damp at time non-shrink grout is placed.
- E. Install equipment in accordance with manufacturer's installation instructions and recommendations.
- F. Grouting under equipment bases, baseplates, soleplates, and skids:
 - 1. Unless otherwise indicated on the Drawings, grout with non-shrink grout as specified in Section 03_60_00 - Grouting:
 - a. Non-shrink epoxy grout required only when indicated on the Drawings.
 - 2. Comply with equipment manufacturer's installation instructions for grouting spaces, and tolerances for level and vertical and horizontal alignment.
 - 3. Install grout only after:
 - a. Equipment is leveled and in proper alignment.
 - b. Piping connections are complete and in alignment with no strain transmitted to equipment.
 - 4. Do not use leveling nuts on equipment anchors for supporting and leveling equipment bases, baseplates, soleplates, and skids for grouting.
 - 5. Use jack screws for supporting and leveling equipment bases, baseplates, soleplates, and skids for grouting following the procedure defined below:
 - a. Drill and tap equipment base plates, sole plates, and skids for jack screws.
 - b. Use suitable number and size of jack screws.
 - c. End of jack screws shall bear on circular steel plates epoxy bonded to equipment foundation.
 - d. Jack screw threads that will be in contact with grout: Wrap with multiple layers of tape or other material, acceptable to Engineer, to prevent grout from bonding to threads.

- e. Place and cure grout as specified in Section 03_60_00 - Grouting.
 - f. After grout is cured, remove jack screws and material used to prevent bonding to grout:
 - 1) Provide jack screws to Owner for future use.
 - g. Tighten equipment anchors in accordance with equipment manufacturer requirements.
 - h. Fill holes where jack screws have been removed with grout.
 - i. Cure as specified in Section 03_60_00 - Grouting.
6. For equipment bases, baseplates, soleplates, and skids where it is not practical to use jack screws, use steel wedges and shims:
- a. Wrap wedges and shims that contact grout with multiple layers of tape or other material, acceptable to Engineer, to prevent grout from bonding.
 - b. Place and cure grout as specified in Section 03_60_00 - Grouting.
 - c. Remove wedges or shims.
 - d. Tighten equipment anchors to in accordance with equipment manufacturer requirements.
 - e. Fill voids where wedges and shims have been removed with grout.
 - f. Cure as specified in Section 03_60_00 - Grouting.
7. Preparation of equipment bases, baseplates, soleplates, and skids for grouting:
- a. Metal in contact with grout: Grit blast to white metal finish.
 - b. Clean surfaces of equipment bases, baseplates, soleplates, and skids in contact with grout of dirt, dust, oil, grease, paint, and other material that will reduce bond.
8. Preparation of concrete equipment foundation for grouting:
- a. Rough concrete surfaces in contact with grout.
 - b. Concrete contact surface shall be free of dirt, dust, laitance, particles, loose concrete, or other material or coatings that will reduce bond.
 - c. Saturate concrete contact surface area with water for minimum of 24 hours prior to grouting.
 - d. Remove standing water just prior to grout placement, using clean rags or oil-free compressed air.
9. Forms and header boxes:
- a. Build forms for grouting of material with adequate strength to withstand placement of grouts.
 - b. Use forms that are rigid and liquid tight. Caulk cracks and joints with an elastomeric sealant.
 - c. Line forms with polyethylene film for easy grout release. Forms carefully waxed with 2 coats of heavy-duty paste wax will also be acceptable.
10. Grout placement requirements:
- a. Minimum ambient and substrate temperature: 45 degrees Fahrenheit and rising:
 - 1) Conform to grout manufacturer's temperature requirements.
 - b. Pour grout using header box.
 - c. Keep level of grout in header box above bottom of equipment bases, baseplates, soleplates, and skids at all times to prevent air entrapment.
 - d. Grout shall flow continuously from header box to other side of forms without trapping air or forming voids.
 - e. Vibrate, rod, or chain grout to facilitate grout flow, consolidate grout, and remove entrapped air.
 - f. After grout sets, remove forms and trim grout at 45-degree angle from bottom edge of equipment bases, baseplates, soleplates, and skids.

g. Cure as specified in Section 03_60_00 - Grouting.

G. Field welding:

1. Use welding procedures, welders, and welding operators qualified and certified in accordance with AWS D1.1.
2. Shielded arc welding.

H. Field finishes:

1. Protect motors.
2. Clean equipment.
3. Apply primer and coating systems as specified in Section 09_96_01 - High-Performance Coatings requirements.

I. Special techniques:

1. Use applicable special tools and equipment, including precision machinist levels, dial indicators, and gauges as required in equipment installations.

J. Tolerances:

1. Completed equipment installations: Comply with requirements for intended use and specified vibration and noise tolerances.

K. Warning signs:

1. Mount securely with stainless fasteners at equipment that can be started automatically or from remote locations.

3.03 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning.

B. Functional testing requirements unless specified otherwise in the individual equipment specifications:

1. Mechanical equipment: Level 1 tests as specified in Section 46_05_94 - Mechanical Equipment Testing.
2. Vendor control panels: As specified in Section 40_90_00 - Instrumentation and Controls.

END OF SECTION

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SECTION 46_05_11

EQUIPMENT IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Equipment nameplates.
 - 2. Special items.

1.02 SUBMITTAL

- A. Submit as specified in Section 01_33_00 - Submittal Procedures.
- B. Shop drawings:
 - 1. Product data.
 - 2. Installation instructions.
- C. Samples.

PART 2 PRODUCTS

2.01 EQUIPMENT NAMEPLATES

- A. Material and fabrication:
 - 1. Stainless steel sheet engraved or stamped with text, holes drilled, or punch for fasteners.
- B. Fasteners:
 - 1. Number 4 or larger oval head stainless steel screws or drive pins.
- C. Text:
 - 1. Manufacturer's name, equipment model number and serial number, identification tag number; and when appropriate, drive speed, motor horsepower with rated capacity, pump rated total dynamic head, and impeller size.

2.02 SPECIAL ITEMS

- A. Paint minimum 2 inches high numbers on or adjacent to accessible valves, pumps, flowmeters, and other items of equipment which are indicated on the Drawings or in Specifications by number.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify satisfactory conditions of substrate for applying identification.
- B. Verify that conditions are satisfactory for installation and application of products as specified in Section 01_60_00 - Product Requirements.

3.02 PREPARATION

- A. Prepare and coat surfaces of special items as specified in Section 09_96_01 - High-Performance Coatings.
- B. Prepare surface in accordance with product manufacturer's instructions.

END OF SECTION

SECTION 46_05_94

MECHANICAL EQUIPMENT TESTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Testing of mechanical equipment and systems.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. S1.4 Specification for Sound Level Meters.
- B. Hydraulic Institute (HI).
- C. National Institute of Standards and Technology (NIST).

1.03 SUBMITTALS

- A. Provide Source Test Plans as specified in Section 01_75_17 - Commissioning.
- B. Provide Installation and Functional Testing Plans as specified in Section 01_75_17 - Commissioning.
- C. Provide vendor operation and maintenance manual as specified in Section 01_78_24 - Operation and Maintenance Manuals.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 GENERAL

- A. Commissioning of equipment as specified in:
 - 1. This Section.
 - 2. Section 01_75_17 - Commissioning.
 - 3. Equipment sections:
 - a. If testing requirements are not specified, provide Level 1 Tests.
- B. Test and prepare piping as specified in Section 40_05_00.09 - Piping Systems Testing prior to equipment testing.
- C. Operation of related existing equipment:
 - 1. Owner will operate related existing equipment or facilities necessary to accomplish the testing.

2. Schedule and coordinate testing as required by Section 01_75_17 - Commissioning.
- D. Provide necessary test instrumentation that has been calibrated within 1 year from date of test to recognized test standards traceable to the NIST or approved source:
1. Properly calibrated field instrumentation permanently installed as a part of the Work may be utilized for tests.
 2. Prior to testing, provide signed and dated certificates of calibration for test instrumentation and equipment.
- E. Test measurement and result accuracy:
1. Use test instruments with accuracies as recommended in the appropriate referenced standards. When no accuracy is recommended in the referenced standard, use 1 percent or better accuracy test instruments:
 - a. Improved (lower error tolerance) accuracies specified elsewhere prevail over this general requirement.
 2. Do not adjust results of tests for instrumentation accuracy:
 - a. Measured values and values directly calculated from measured values shall be the basis for comparing actual equipment performance to specified requirements.

3.02 VARIABLE SPEED EQUIPMENT TESTS

- A. Establish performance over the entire speed range and at the average operating condition.
- B. Establish performance curves for the following speeds:
1. The speed corresponding to the rated maximum capacity.
 2. The speed corresponding to the minimum capacity.
 3. The speed corresponding to the average operating conditions.

3.03 NOISE REQUIREMENTS AND CONTROL

- A. Perform noise tests in conjunction with vibration test analysis.
- B. Make measurements in relation to reference pressure of 0.0002 microbar.
- C. Make measurements of emitted noise levels on sound level meter meeting or exceeding ANSI S1.4, Type II.
- D. Set sound level meter to slow response.
- E. Unless otherwise specified, maximum free field noise level not to exceed 85 dBA measured as sound pressure level at 3 feet from the equipment.

3.04 PRESSURE TESTING

- A. Hydrostatically pressure test pressure containing parts at the appropriate standard or code required level above the equipment component specified design pressure or operating pressure, whichever is higher.

3.05 TESTING LEVELS

A. Level 1 Tests:

1. Level 1 General Equipment Performance Test:
 - a. For equipment, operate, rotate, or otherwise functionally test for 15 minutes minimum after components reach normal operating temperatures.
 - b. Operate at rated design load conditions.
 - c. Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
2. Level 1 Pump Performance Test:
 - a. Measure flow and head while operating at or near the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.
 - b. Record measured flow, suction pressure, discharge pressure, and make observations on bearing temperatures and noise levels.
3. Level 1 Vibration Test:
 - a. Test requirement:
 - 1) Measure filtered vibration spectra versus frequency in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component.
 - 2) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.
 - b. Equipment operating condition: Test at specified maximum speed.
4. Level 1 Noise Test:
 - a. Measure unfiltered overall A-weighted sound pressure level in dBA at 3 feet horizontally from the surface of the equipment and at a mid-point of the equipment height.

B. Level 2 Tests:

1. Level 2 General Performance Test:
 - a. For equipment, operate, rotate, or otherwise functionally test for at least 2 hours after components reach normal operating temperatures.
 - b. Operate at rated design load conditions.
 - c. Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
2. Level 2 Pump Performance Test:
 - a. Test 2 hours minimum for flow and head at the rated condition; for factory testing, testing may be at a reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.
 - b. Test for flow and head at 2 additional conditions; 1 at 25 percent below the rated flow and 1 at 10 percent above the rated flow.

- c. Record measured flow, suction pressure, discharge pressure, and observations on bearing temperatures and noise levels at each condition.
3. Level 2 Vibration Test:
- a. Test requirement:
 - 1) Measure filtered vibration spectra versus frequency and measure vibration phase in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component; measure actual rotational speeds for each vibration spectra measured using photometric or other tachometer input connected directly to the vibration data collector.
 - 2) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.
 - b. Equipment operating condition: Repeat test requirements at design specified maximum speed and at minimum speed for variable speed equipment.
 - c. Natural frequency test of field installed equipment:
 - 1) Excite the installed equipment and support system in 3 perpendicular planes, use same planes as operating vibration measurement planes, and determine the as-installed natural resonant frequency of the driven equipment, the driver, gears, and supports.
 - 2) Perform test at each bearing housing, at each support pedestal, and for pumps on the suction and discharge piping.
 - 3) Perform with equipment and attached piping full of intended service or process fluid.
4. Level 2 Noise Test:
- a. Measure filtered A-weighted overall sound pressure level in dBA for each of 8 octave band mid-points beginning at 63 hertz measured at 3 feet horizontally from the surface of the equipment at mid-point height of the noise source.
- C. Level 3 Tests:
- 1. Level 3 General Equipment Performance Tests:
 - a. For equipment, operate, rotate, or otherwise functionally test for at least 4 hours after components reach normal operating temperatures.
 - b. Operate at rated design load conditions for 1/2 the specified time; operate at each of any other specified conditions for a proportionate share of the remaining test time.
 - c. Confirm that equipment is properly assembled, equipment rotates in the proper direction, shafting and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual noise, vibration, or temperatures are observed.
 - d. Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure, and temperature readings using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.
 - e. Bearing temperatures: During maximum speed or capacity performance testing, measure and record the exterior surface temperature of each bearing versus time.
 - 2. Level 3 Pump Performance Test:
 - a. Test 4 hours minimum for flow and head at or near the rated condition; for factory testing, testing may be at reduced speeds with flow and head

corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.

- b. Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 15 minutes; for factory testing, test at other speeds may be omitted if test driver at reduced speeds is used for rated condition testing.
 - c. Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices are not required by the equipment section) and record observations on noise levels.
3. Level 3 Vibration Test:
- a. Requirements: Same as Level 2 vibration test except data taken at each operating condition tested and with additional requirements below.
 - b. Perform High Frequency Enveloping Analysis for gears and bearings:
 - 1) Measure bearing element vibration directly on each bearing cap in a location close as possible to the bearing load zone that provides a smooth surface and direct path to the bearing to detect bearing defects.
 - 2) Report results in units of acceleration versus frequency in cycles per minute.
 - c. Perform Time Wave Form analysis for gears, low speed equipment and reciprocating equipment; plot true peak amplitude velocity and displacement versus time and label the period between peaks with the likely cause of the periodic peaks (relate the period to a cause).
 - d. Plot vibration spectra on 3 different plots; peak displacement versus frequency, peak acceleration versus frequency and peak velocity versus frequency.
4. Level 3 Noise Test: Measure filtered, un-weighted overall sound pressure level in dB at 3 feet horizontally from the surface of the equipment at mid-point height and at 4 locations approximately 90 degrees apart in plain view; report results for each of 8 octave band mid-points beginning at 63 hertz.

D. Level 4 Tests:

1. Level 4 General Equipment Performance Test:
 - a. For equipment, operate, rotate, or otherwise functionally test for at least 8 hours after components reach normal operating temperatures.
 - b. Operate at rated design load conditions for 1/2 the specified time; operate at each of any other specified conditions for a proportionate share of the remaining test time.
 - c. Confirm that equipment is properly assembled, equipment rotates in the proper direction, shafting and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual noise, vibration, or temperatures are observed.
 - d. Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure and temperature readings, using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.
 - e. Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.

2. Level 4 Pump Performance Test:
 - a. Test 8 hours minimum for flow and head; begin tests at or near the rated condition; for factory and field-testing, test with furnished motor at full speed.
 - b. Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 20 minutes or longer as necessary to measure required performance, vibration, and noise data at each test condition.
 - c. Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices not required by the equipment section) and record observations on noise levels.
 - d. Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.
 - e. Perform efficiency and/or Net Positive Suction Head Required (NPSHr) and/or priming time tests when specified in the equipment section in accordance with the appropriate HI standard and as follows:
 - 1) Perform NPSHr testing at maximum rated design speed, head and flow with test fluids at ambient conditions; at maximum rated speed, test at 15 percent above rated design flow, and 25 percent below rated design flow.
 - 2) Perform efficiency testing with test fluids at maximum rated speed.
 - 3) Perform priming time testing with test fluids at maximum rated speed.
3. Level 4 Vibration Test: Same as Level 3 vibration test.
4. Level 4 Noise Test: Same as Level 3 Noise Test except with data taken at each operating condition tested.

END OF SECTION

SECTION 46_41_44

POTABLE WATER TANK MIXER

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Submersible tank mixing systems intended for continuous use while submersed in potable water storage tanks.
 - 2. Each mixer shall have the ability to function continuously on a year-round basis, regardless of tank drain and fill cycles.
 - 3. Each mixer shall consist of a submersible motor, mixer element, submersible housing, retrieval chain, retrieval chain mounting bracket, and an exterior mounted control panel.

1.02 REFERENCES

- A. National Electrical Manufacturers Association (NEMA):
 - 1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).
- B. NSF International (NSF):
 - 1. Standard 61 - Drinking Water System Components-Health Effects.
- C. Occupational Safety and Health Administration (OSHA).

1.03 DEFINITIONS

- A. NEMA:
 - 1. Type 4X enclosure in accordance with NEMA 250.

1.04 QUALITY ASSURANCE

- A. General: As specified in Section 46_05_10 - Common Work Results for Mechanical Equipment and Section 26_05_00 - Common Work Results for Electrical.
- B. The mixing equipment specified in this Section shall be the design and fabrication by a single manufacturer, which shall have sole source responsibility for said equipment.
- C. No visual defects: The mixer shall have no visual defects, and shall have high quality welds, assembly, and corrosion resistant finish.
- D. Qualified manufacturer: The manufacturer of the mixer shall have at least 5 years of experience in the production of such equipment for mixing in water storage tanks.
- E. Mixer: The furnished model shall be a model that has been in continuous service under similar service conditions for at least 5 years. Provide references for 5 such installations.

- F. Factory start-up services: Start-up services shall be included. Factory services shall be performed by full-time factory employees experienced in the operation of this equipment and who have completed OSHA safety trainings applicable to this type of installation.

1.05 SUBMITTALS

- A. Contractor shall provide the following documents as specified in Section 01_33_00 - Submittal Procedures:
 - 1. A qualification statement demonstrating compliance with the Quality Assurance section.
 - 2. Shop drawings for the mixer.
 - 3. Manufacturer's literature, illustrations, and specification sheets defining materials of construction, dimensions, and weights.
 - 4. A copy of the warranty statement.
 - 5. Control panel construction and wiring details as specified in the Electrical and Controls sections.
- B. Final submittals shall include:
 - 1. A complete installation, operation, and maintenance manual.
 - 2. Each mixing system shall be tested prior to deployment according to standard engineering practices at the factory testing facilities. Certification of this completed testing shall accompany mixer installation documentation. Factory testing to include the following:
 - a. Propeller, motor rating, and electrical connections shall be checked for compliance to the specifications.
 - b. All mixers shall be run dry and/or immersed to determine correct shaft rotation, thrust direction, and power consumption.
 - c. After immersion test(s), all mixers shall be inspected for water infiltration, insulation defect(s), and motor resistance (ohms).
 - 3. O&M manuals as specified in Section 01_78_24 - Operation and Maintenance Manuals.

1.06 WARRANTY

- A. As specified in Section 01_78_36 - Warranties and Bonds.
- B. Special warranty:
 - 1. Mixer shall be warranted to be free of defects in materials and workmanship for a period of 3 years.

1.07 MAINTENANCE

- A. Spare parts: Provide 1 set of the following items for each type and size required by the units:
 - 1. O-rings.
 - 2. Bearings.
 - 3. Mechanical seals.
 - 4. Power cable grommet.
- B. Special tools: Provide 1 set of special tools of each type and size required by the units.

PART 2 PRODUCT SPECIFICATIONS

2.01 MANUFACTURERS

- A. One of the following, or equal:
1. PAX Water Technologies of San Rafael, CA, model PWM.

2.02 PERFORMANCE AND FEATURES

- A. Number of units required and water storage tank data:

Mixer Qty	Tank Capacity (gal)	Tank Diameter (ft)	Tank Side Wall Height Side Wall (ft)	High Water Level (ft)	Low Water Level (ft)	Access Manhole Diameter (in)
1	4,000,000	148	32	28	20	24
1	4,000,000	148	32	28	20	24

- B. Stainless steel construction:
1. The mixer body and motor shall be constructed Type 304 or 316 stainless steel with stainless steel retrieval chain and stainless steel retrieval chain bracket mounted near the tank access hatch.
 2. Other non-metallic parts will be polyethylene and EPDM.
- C. Motor: The mixer shall be mechanically operated by a submersible motor that meets the following criteria:
1. Direct drive, with no gearbox and no lubrication maintenance required.
 2. Designed for submersible operation.
 3. Designed for continuous operation without overheating or compromising motor life expectancy.
 4. Power and control wires and their termination at the motor shall be armored, waterproof cable attached to the motor with waterproof fittings and strain relief. Cable length to reach from the motor when installed inside the tank to the control panel mounted on a post near the tank wall plus 15 feet. No splices shall be permitted.
 5. Motor shall have a service factor of at least 1.15 under all operating conditions.
 6. NEMA design B with Class F insulation.
 7. Motor power: 0.5 horsepower, minimum.
- D. The mixing system shall be NSF Standard 61 for safe contact with potable water.
- E. Maintenance requirements: The mixer shall operate normally with no scheduled lubrication is required.
- F. Installation requirements as follows:
1. Mixer shall be self-orienting when installed at bottom of tank.
 2. Mixer shall not weigh more than 50 pounds.
 3. Mixer shall not damage tank interior coating during installation and operation.
 4. Mixer shall fit through existing access manholes without modifications to the tank.

2.03 CONTROL PANEL

- A. Control panel shall consist of the following components:
 - 1. Enclosure:
 - a. Shall have the following features:
 - 1) Lockable.
 - 2) NEMA 4X.
 - 3) As specified in the Electrical and Controls specification sections for panel construction requirements.
 - b. Enclosure shall be post mounted as shown on the Drawings.
 - 2. Power supply: 120 VAC Power.
 - 3. Temperature range: -40 to 70 degrees Celsius.
 - 4. Motor controller:
 - a. Hand/Off/Auto switch.
 - b. Run indicator light.
 - c. Overload protection.
 - d. 4-20 ma motor current output.
 - e. Remote start/stop inputs.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and as specified in Section 46_05_10 - Common Work Results for Mechanical Equipment.

3.02 FIELD SERVICES

- A. Factory personnel: The start-up shall be performed by full-time factory employees trained in the operation of the potable water mixer.

3.03 FIELD QUALITY CONTROL

- A. Witnessing: All field testing shall be witnessed by the Engineer; provide advanced notice of field testing as specified in Section 46_05_94 - Mechanical Equipment Testing.
- B. Inspection and checkout: As specified in Sections 46_05_10 - Common Work Results for Mechanical Equipment and 46_05_94 - Mechanical Equipment Testing.
- C. Equipment performance test: Test for complete mixing; test as specified in this Section and Section 46_05_94 - Mechanical Equipment Testing.
- D. Operational testing: As specified in Section 01_75_17 - Commissioning. Temperature, noise, and vibration testing specified within the general equipment performance and pump performance test sections is not required.

3.04 MANUFACTURER'S FIELD SERVICE

- A. Require manufacturer to inspect system before initial testing and start-up and certify that system has been correctly installed and prepared for testing and start-up as specified in this Section and in Sections 01_75_17 - Commissioning, 46_05_10 - Common Work Results for Mechanical Equipment, and 46_05_94 - Mechanical Equipment Testing.

END OF SECTION

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SECTION 46_61_27

ON-SITE SODIUM HYPOCHLORITE GENERATION EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
1. On-Site Sodium Hypochlorite Equipment with associated appurtenances, auxiliary equipment, and control interfaces.
- B. Scope:
1. This Section covers the work necessary by the Contractor and On-site Sodium Hypochlorite Generation System (OSHGS) Supplier (Supplier), to furnish, install, test, and make ready for operation a complete OSHGS. The OSHGS includes, but is not limited to, the sodium hypochlorite generator units with integral piping, valves, brine pumps, and control interface and microprocessor. The OSHGS off unit components include but is not limited to, water softener, filters, hydrogen dilution blower, level instrumentation, other instrumentation, and ancillary equipment as specified herein. Other services include installation, testing, start-up, training, and maintenance support. All unit-mounted electrical and instrumentation wiring shall be provided the Supplier.
 2. The Supplier shall furnish the following components of the OSHGS:
 - a. Sodium Hypochlorite Generation wall mounted units with power supplies, microprocessor, control interface, and system enclosure.
 - b. Sodium Hypochlorite Generation cells and power supplies.
 - c. Unit mounted interconnect piping, valves (including, but not limited to, check valves, pressure reducing valves, manual ball valves, electrically actuated water supply valve), brine pumps, rotameters, filters, pressure gauges, pressure transmitters, flow meters, and accessories associated with the generation units.
 - d. Hydrogen dilution blower, air flow sensor, and associated pressure gauges and air filters.
 - e. One hydrogen gas analyzer and one chlorine gas analyzer.
 - f. Brine tank level controls and discharge filter.
 - g. Product tank level instrumentation and high-level float switch.
 - h. Water softener.
 - i. Networking communication components.
 - j. Spare Parts.
 3. The Supplier shall inspect the installation of the OSHGS and any errors shall be corrected by the Contractor. Following the correction of all errors, the Supplier shall provide a Certification of Proper Installation for the OSHGS.
 4. The Supplier shall be responsible for programming the OSHGS package control software.
 5. The Supplier shall perform functional, performance, and start-up testing of the OSHGS. The Contractor shall notify the Supplier at least 30 days before the scheduled date for performing these tests and shall coordinate testing requirements and scheduling with the Engineer and Owner.

6. The Supplier shall submit an Operation and Maintenance (O&M) Manual for the OSHGS. The O&M Manual and Forms shall be reviewed by the Contractor and issued to the Engineer for review and approval.
7. The Supplier shall train Owner's personnel and provide detailed instructions in the operation of the OSHGS.

C. General:

1. All electrical, mechanical, metal, painting and instrumentation work included herein shall conform to the applicable Sections or Divisions of this project except as otherwise shown or specified. Each OSHGS panel shall be shipped as one self-contained unit with all factory piping and wiring complete to input and output, threaded, etc. connections located at easily accessible points on the unit.
2. The Supplier shall warrant and support all of the components listed above as if they were components of its own manufacture regardless of the source. The Supplier shall supply all component pieces and maintain an overall "single source responsibility" for the complete system.
3. The Drawings show a layout of the OSHGS units, various components, P&IDs, and the system's overall relationships. Not all items incidental to the sodium hypochlorite generator feed system are shown or specified. It is the intent of these Specifications that the Supplier is to provide a complete and workable system whether or not any specific component is shown or specified.
4. Power shall be provided by the Contractor to the system as indicated in the Drawings. The Contractor shall be responsible for providing all necessary conduit and wiring necessary for a complete electrical service to this location.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 1. National Science Foundation (NSF) / ANSI Standard 60: Drinking Water Treatment Chemicals – Health Effects.
 2. NSF / ANSI Standard 61: Drinking Water System Components – Health Effects.
- B. American Society for Quality Control (ASQC).
- C. American Society of Mechanical Engineers (ASME).
- D. American Society for Testing Materials (ASTM).
- E. American Water Works Association (AWWA).
- F. The Chlorine Institute (CI).
- G. International Standards Organization (ISO).
- H. National Electrical Code (NEC) – 2014.
- I. National Electrical Manufacturer's Association (NEMA).
- J. National Institute of Occupational Safety & Health (NIOSH).
- K. Occupational Safety and Health Administration (OSHA).

1.03 DEFINITIONS

- A. Anode - The positively charged electrode in a DSA. Anodes attract electrons or anions and are the part of a DSA where oxidants are formed.
- B. Brine Tank - A tank used to hold the brine solution (salt and softened water) prior to electrolysis in an electrolytic cell.
- C. Calcium Carbonate - A solid that tends to form in the high-pH conditions present at the cathodes of DSA electrolytic cells. Also referred to as hardness.
- D. Cathode - The negatively charged electrode in a DSA. Cathodes attract cations and a cathode is an electron donor.
- E. Chlorine - a chemical used as a disinfectant and oxidizing agent.
- F. Current -The movement of charged particles.
- G. Electrolyte -The solution that is passed through an electrolytic cell. In the case of OSG, the electrolyte is a brine (NaCl) solution.
- H. Free Available Chlorine (FAC) - The amount of chlorine available as dissolved gas (Cl₂), hypochlorous acid (HOCl), and hypochlorite ion (OCl⁻), that is not combined with ammonia (NH₃) or other compounds in water and that is available for disinfection or oxidation.
- I. Hydrogen Gas (H₂) - A by-product of chlorine generation processes. Hydrogen gas can be explosive at the lower explosive limit and higher explosive limit. (The flammability limits based on the volume percent of hydrogen in air at 1 atm are approximately 4 percent and 75 percent.) During the installation of an OSG, hydrogen gas must be properly mitigated via dilution or blower systems.
- J. Low-Strength OSG - Describes any system that produces hypochlorite at <1 percent (<10,000 ppm F.A.C.).
- K. On-Site Generation (OSG or OSHG) - General term to describe hypochlorite that is made on-site from salt: the process of generating an oxidant from a salt solution and electricity at the site where the chemical will be used. In this manual, OSG is used interchangeably with OSHG, but can also be used as a general term for generating a chemical on-site.
- L. Power - Rate of energy flow in joules/second (watt).

1.04 DESIGN AND PERFORMANCE CRITERIA

- A. Process Design:
 - 1. Design Criteria:
 - a. Minimum/Average/Maximum process flow: 0.5 / 2.1 / 4.4 mgd.
 - b. Minimum/Average/Maximum chlorine dose: 0.2 / 0.5 / 1.0 mg/L.
 - c. Minimum/Average/Maximum chlorine daily usage: 0.8 / 8.8 / 37 ppd.
 - d. Capacity per unit as equivalent chlorine: 20 ppd.
 - e. Total number of units: 3.
 - f. Total number of cells per unit: 4.

- g. Total system capacity as equivalent chlorine: 60 ppd.
 - h. Design minimum/maximum water temperature: 41 / 86 deg. F.
 - i. Design water total hardness: 17 mg/L as CaCO₃.
 - j. Design minimum/maximum water pressure: 29 / 72 psi.
2. The electrolytic system shall generate an aqueous solution of a minimum concentration of 0.7 percent (±0.05 percent) by weight or 7,000 ppm sodium hypochlorite expressed as chlorine equivalent.
 3. The electrolytic cell shall consume a maximum of 3.1 lbs. of salt per pound of chlorine equivalent output, using salt containing no organic binders, flow control agents or resin cleaning material, and in accordance with EN 14805.
 4. The electrolytic cell shall consume a maximum of 2.0 A.C. kilowatt hours of electricity per pound of chlorine equivalent output.
 5. The electrolytic cell shall consume a maximum of 16.0 gallons of softened water per pound of chlorine equivalent output.
 6. Hydrogen Management:
 - a. The generators shall have no waste products associated with its use other than hydrogen gas, which is to be vented to the atmosphere. Hydrogen Dilution blowers will be used to purge all residual hydrogen out of the system.
 - b. Each generator shall be designed to allow passive venting of the waste hydrogen produced from each cell.
 7. The generator shall be built and configured to allow one of the electrolytic cells to be removed and still run at reduced production capacity with only minor adjustments to the required generator controls.
 8. The sodium hypochlorite generator assembly shall be factory tested and proper operating parameters confirmed prior to shipment. QA/QC certification shall document that unit test settings are noted prior to shipping. The Owner (or Engineer) has the right to attend the factory acceptance testing and shall be informed by the Supplier one month prior to the scheduled test.

1.05 SUBMITTALS

- A. Shop drawings:
 1. Manufacturer/Supplier's literature, illustrations, specifications and bill of materials for each component of the system. Data shall include a complete description in sufficient detail to permit comparison with the technical Specifications.
 2. Dimensions, materials, size, weight and performance data.
 3. Drawings showing fabrication, assembly, installation and wiring diagrams. Wiring diagrams shall consist of, at a minimum, control schematics, including coordination with other electrical control devices operating in conjunction with the sodium hypochlorite generator feed system.
 4. A list of any and all parameters, ratings, or other characteristics where the proposed sodium hypochlorite generator system deviates from the requirements set forth in these Specifications.
 5. Affidavits of compliance with referenced standards and codes including NSF 61 certification for equipment.
 6. Manufacturer/Supplier's standards for sodium hypochlorite generation equipment.
 7. The Supplier shall provide calculations showing all relevant cell data. Data shall include electrode area measurements, and current flows. Electrode

service factor shall be expressed as amps per square inch of active electrode surface.

8. Calculations and other information to substantiate supports and anchor bolts meet minimum design strength requirements specified herein for generator panels. Calculations for connection details demonstrating compliance with specified structural design requirements. A Professional Engineer registered in state of Washington shall stamp and sign calculations.
9. Dimensioned inlet/outlet system connections.
10. The acceptable range of water pressure for proper system operation.
11. Process Control and Instrumentation:
 - a. Hardware Submittal:
 - 1) Bill of Materials.
 - 2) ISA S20 data sheets for all instruments provided.
 - 3) Catalog cuts for all process control and instrumentation equipment.
 - 4) Detailed control panel drawings including assembly/layout drawings and heating/cooling calculations.
 - 5) Instrument installation, mounting, and anchoring details.
 - b. Detailed schematic drawings for all control equipment.
 - c. Detailed loop drawings per ISA S5.4. Submittal of generic diagrams will not be acceptable. Loop drawings shall contain all of the minimum and optional content required by the paragraphs 5.2 and 5.3 of the standard.
 - d. Point-to-point interconnection wiring diagrams.
 - e. Panel wiring and piping diagrams.
 - f. English-language loop descriptions.
 - g. Instrument index with ranges and set points.
 - h. A fully documented functional block diagram PLC program listing including the I/O list and housing configuration for each PLC.
 - i. Each function block logic must be associated with a complete English language narrative describing the function and operation of said rung.
 - j. Color copies of all proposed operator interface screens.
 - k. Detailed factory testing procedure.
 - l. Training plan submittal.

B. Operation and Maintenance Data:

1. Submit complete Operation and Maintenance manuals and an electronic copy in accordance with Section 01_78_24 - Operation and Maintenance Manuals and the requirements described below.
2. Required Operation Data:
 - a. Complete, detailed operating instructions for each piece of equipment.
 - b. Explanations for all safety considerations relating to operations.
 - c. Recommended spare parts lists.
 - d. List of anticipated replacement timeframes for all major components. This should include rectifiers, cells, blowers, sodium hypochlorite transfer pumps, brine pumps, all valves, and instrumentation at a minimum.
3. Required Maintenance Data:
 - a. Maintenance data shall include all information and instructions required by plant personnel to keep equipment properly cleaned, lubricated and adjusted so that it functions economically throughout its full design life.
 - b. Explanation with illustrations as necessary for each maintenance task. A detailed explanation of the cleaning process is required for the O&M manual. This shall include a step-by-step process with photos of the

equipment, connection points, and hazards associated with the chemicals and process.

- c. Recommended schedule of maintenance tasks.
- d. Troubleshooting instructions.
- e. List of maintenance tools and equipment.
- f. Name, address and phone number of manufacturer and manufacturer's local service representative.
- g. 24-hour 365-days toll-free service hotline.

C. Storage and handling instruction.

D. Installation instructions.

E. Copy of OSHG Manufacturer's NSF-61 certification for the size of the OSHG System proposed.

F. Warranty, quality assurance information, and associated certifications.

1.06 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. The OSHGS Supplier shall have at least 5 years' experience in the design and manufacture of equipment of similar capacity and service capability to the equipment described herein. As part of their bid submittal package, the system manufacturer shall submit the following:
 - a. Evidence that equipment of similar design has been in successful operation in at least 10 separate installations within the continental United States.
 - b. Verify that the sodium hypochlorite generation equipment shall be pre-assembled and factory tested to assure compliance with all operational requirements. No field assembly or wiring will be permitted with the exception of external conduits.
 - c. Disclosure of any and all installations with safety incidents and descriptions of any design changes as a results of those incidents. Failure to report any known incidences will result in disqualification.
2. The OSHG Manufacturer shall have a local service center familiar with OSHG operations and maintenance with a 24/7 contact number capable of providing same day response. The service center shall have at least 5 years of operational OSHG experience.

1.07 DELIVERY, STORAGE AND HANDLING

A. Delivery, storage, and handling as specified in this specification and in Section 46_05_10 - Common Work Results for Mechanical Equipment.

B. All equipment and materials shall be inspected against approved Shop Drawings at time of delivery. Equipment and materials damaged or not meeting requirements of the approved Shop Drawings shall be immediately returned to the Supplier for replacement or repair.

C. Equipment and materials shall be stored in a dry location and protected from the elements according to the Supplier's instruction.

- D. Equipment and materials shall be handled in an approved manner according to the Supplier's instructions.
- E. Deliveries shall be made in accordance with Section 01_14_00 - Work Restrictions. All deliveries shall be coordinated in advance with Contractor.

1.08 WARRANTY

- A. Prior to final acceptance of the sodium hypochlorite OSHGS, provide written warranty from the system manufacturer that includes the following statements:
 - 1. Supplier shall inspect the installation during and after completion and provide written certification that the sodium hypochlorite OSHGS is free from faults and defects and is in conformance with the Contract Documents and Supplier's requirements.
 - 2. Supplier must provide the following after sales services:
 - a. 24-hour 365-day toll free service hot-line.
 - b. Next day technician availability.
 - c. Same day or overnight parts availability.
 - d. Must provide evidence of spare parts availability on this system such as cells, rectifiers, control cabinets, blowers, brine pumps, and sodium hypochlorite transfer pumps.
 - 3. Sodium hypochlorite generator system including all equipment specified herein, will remain free of defects for a period of 2 years from the date of final acceptance. Final acceptance shall begin after successful completion of the 10 day performance testing.
 - 4. If the equipment requires repair or replacement during the 2 year warranty period as a result of ordinary wear and tear under normal conditions, the Supplier will repair or replace such equipment as required without cost (including shipping, handling and labor) to the Owner.
 - 5. The electrolytic cells including cell body shall have a 2 year full replacement warranty from the date of commercial operation. This warranty shall include the entire electrolytic cell and not just the electrodes of the cell(s).
 - 6. The warranty period shall start from the final acceptance date of the system.

PART 2 PRODUCTS

2.01 SERVICE CONDITIONS

- A. Feed Points:
 - 1. Under normal operating conditions, sodium hypochlorite generated on-site (0.7 percent) will be supplied to the sodium hypochlorite storage tanks and dosed as needed.
- B. Functional Requirements:
 - 1. Instrumentation, controls, logic, programming, interlocks, and valving shall be provided as required for the system to operate as described below.
 - 2. General arrangement, piping sizes and accessories indicated in the Drawings.

2.02 MANUFACTURERS

- A. On-Site Sodium Hypochlorite Generation System:
 - 1. OSEC L series by Evoqua, or equal.

2.03 ON-SITE SODIUM HYPOCHLORITE GENERATORS

A. General:

1. Provide 3 sodium hypochlorite generators, each capable of producing 20 pounds per day equivalent chlorine in a 0.7 percent sodium hypochlorite solution.
2. The OSHGS shall be mounted in the general location shown on the approved Final Shop Drawings and shall be factory wired, plumbed in a self-contained unit. Each OSHGs shall be pre-piped, wired, and mounted as much as possible. The unit cover shall be easily removable and shall be configured to allow easy access to all components.
3. The generator unit frame shall support as a minimum the following mounted equipment:
 - a. Generator electrolytic cells.
 - b. Electrolytic cell power supplies.
 - c. Controller and local HMI.
 - d. Interconnect pipes valves and fittings.
 - e. Interconnect conduit and wiring.
 - f. Water flow sensor.
 - g. Variable speed brine pump.
4. The generator package shall have the following redundant interlocked safety features:
 - a. Cell high temperature switch or setpoint, for each cell.
 - b. Cell low level switch.
 - c. Water flow sensor setpoint.
 - d. Hydrogen Dilution Air Flow switch for each Blower.
 - e. Overcurrent sensor for each blower.
5. The generator shall be supplied with an electrolyte temperature sensor.
6. The process shall operate in a batch environment allowing for consistent hypochlorite concentrations and greatest efficiencies.
7. Softened water flow shall be controlled on the panel via flow control valve and a pressure reducing valve.

B. Brine Pumps:

1. Supplier shall provide flow controls on the generator unit which shall automatically dilute concentrated brine with softened water to produce a brine solution to be delivered to the electrolytic cells.
2. Supplier shall provide one brine pump per OSHG unit. The brine pump shall be integral to the design of the unit, powered by the unit, and controlled by the LCP. Each brine pump shall be a peristaltic pump with wetted materials compatible with brine solution.
3. Pump shall be capable of self-priming and running dry without damaging effects to any components of the brine system.

C. Electrolytic Cells:

1. The electrolytic cells shall be constructed of clear acrylic materials, allowing for full visual inspection of the electrodes from all angles.
2. The cells must operate at atmospheric pressure while purging hydrogen gas passively at the top of the cell.
3. All D.C. cable connections shall be direct to the outermost electrode for both anode and cathode.
4. The wetted cell components shall consist only of the electrodes and acrylic cell body. No internal baffles, spacers, or connecting hardware will be allowed.

5. The generator shall be built and configured to allow one of the four electrolytic cells to be removed and still run at reduced production capacity with only minor adjustments to the required generator controls.
6. Cells shall utilize titanium bolting hardware.

D. DC Power Supply:

1. Power for the electrolysis of brine shall be provided by a high-efficient dual mode constant voltage and constant current output power supply. The on-site generation system shall consist of 4 power supplies running in parallel to a dedicated electrolyzer cartridge.
2. Input power shall be 100-240 VAC \pm 10 percent single phase at 50/60 Hz. Output to be constant current 32A and 15V DC.
3. Power supply enclosure shall be rated to meet IP67/IP65 certifications suitable for indoor and outdoor operation.
4. Power supply shall have automatic output overload protection.
5. Power supply shall be built to CE/CSA standards.
6. The power supplies shall be mounted in the on-site generation cabinet.
7. Power supply shall be Mean Well HLG-600H series with no exception.

E. Control System: (also reference Instrumentation and Controls specifications sections for other requirements):

1. Manufacturer shall provide all necessary controls, including all motor starters for blowers, pumps, and other equipment, switches, circuit breakers and power disconnecting devices and hardware, indicating lights, transformers, auxiliary contacts, terminal strips, control relays, integrators, PLCs, HMIs, programmers, timers, counters, wiring, and all other components and accessories to supply power to all system components and for system control including all sub-systems as specified herein, and as recommended by manufacturer and required for a complete and operational control system. Instances of Hand-Off-Auto or Local-Off-Remote selector switches or other switches and buttons and indicating lights herein shall refer to virtual devices available through an HMI mounted in door of control panel. Manufacturer shall be responsible for necessary communications hardware and software between control panels supplied by manufacturer and between manufacturer-supplied panels and facility SCADA system. Contractor shall be responsible for providing any additional components required or recommended by manufacturer as well as all necessary conduit, wiring, and accessories between system control panels, other control panels and equipment integral to operation of systems, and between panels, equipment, and Owner's SCADA system to form a complete and operational system. All controls and operation logic specified herein and as shown on instrumentation loop diagrams required for the system shall be programmed in a PLC in each panel.
2. The local control HMI shall display all relevant operating parameters and/or alarm conditions for the specific generator.
3. The Control Cabinet shall contain an Emergency Stop Switch.
4. The generator PLC and display will control and monitor all functions and operational parameters including, but not limited to, the following:
 - a. Redundant cell level and temperature switches.
 - b. Process temperature control.
 - c. Power supply control.
 - d. DC amperage and voltage.
 - e. Maintenance required alarm.

- f. Sodium hypochlorite storage tank levels.
 - g. Hydrogen dilution blower controls.
 - h. Security protection.
 - i. Hydrogen gas concentrations and alarms.
5. Control panels shall be assembled, tested, and programmed for required functionality by manufacturer prior to shipment to work site.

2.04 HYDROGEN SAFETY MANAGEMENT

- A. The hydrogen dilution system shall dilute the hydrogen concentration to below 25 percent of Lower Flammability Limit (LFL) or 1 percent by volume:
1. Hydrogen dilution shall be performed using force draft blower at the sodium hypochlorite storage tank and through passive venting off of the sloped product pipe.
 2. The hydrogen dilution blower shall generate a minimum flow of 42 SCFM. Ultimate sizing and design of the blower shall be determined by the Supplier. The hydrogen dilution system design shall incorporate the following safety features:
 - a. Blower current sensing.
 - b. Air flow sensor in the common sodium hypochlorite tank vent.
 - c. Software controlled safety interlocks to detect control system sequence failure.
 3. Blower and motor sizing, including static pressure, shall be calculated by Supplier based on piping arrangements indicated in the Drawings and as necessary to adequately mitigate hydrogen gas.
 4. Blowers shall be Cincinnati Fans, Model PB; or approved equal. Model to be selected by OSHG system manufacturer based on actual conditions, including blower piping arrangements. Blower shall have 1 inch or 1/2 inch NPT condensate drain connection in the bottom of the fan housing.
 5. Horizontal lines shall have a minimum upward slope toward the vent outlet of approximately 1/4 inch per linear foot.
 6. Hydrogen and Chlorine Gas Room Monitor/Detector:
 - a. One detector for hydrogen gas and one detector for chlorine gas shall be provided. A combined instrument is acceptable.
 - b. The hydrogen and chlorine gas monitoring system shall continuously measure and display gas concentration and provide alarms when preset limits are exceeded (on all HMIs). Transmitter shall be interlocked to local and master control panels.
 - c. Enclosure: NEMA 4X.
 - d. Display: Two-line, 8-character alphanumeric LCD display.
 - e. Output Signal: Linear 4-20 mA.
 - f. Manufacturer and Model: ATI Model D-12 or CONSPEC CN06.
 - g. The monitors shall be installed near the ceiling of Sodium Hypochlorite Generator Room and with a minimum distance of 3 feet from any sodium hypochlorite sampling ports.
 - h. The detector shall provide a warning alarm at 20 ppm of hydrogen gas and stop production of sodium hypochlorite at 50 ppm.
 - i. The monitors' installation shall include a pulley system to allow it to be lowered to the floor level without requiring an operator to climb to the monitor.

APPENDIX A PREVAILING MINIMUM HOURLY WAGE RATES

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PREVAILING WAGES

The State of Washington prevailing wage rates for King County apply to work performed under this contract. The applicable prevailing wage rates may be found at the following website address of the Department of Labor and Industries:

<https://lni.wa.gov/licensing-permits/public-works-projects/prevailing-wage-rates/>

Based on the bid submittal date for this project, the applicable date for prevailing wages for this project is March 17, 2021. A copy of the applicable prevailing wage rates are also available for viewing at the City of Mercer Island, Maintenance Department located at 9611 SE 36th Street.

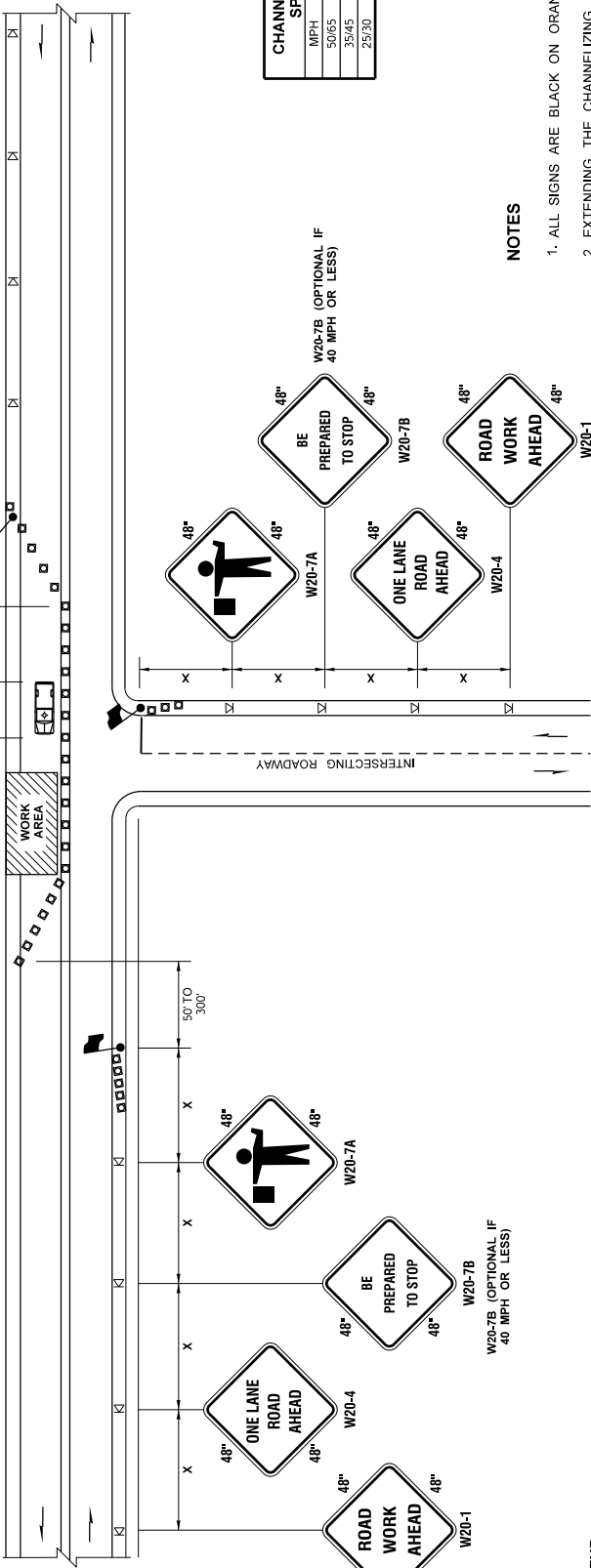
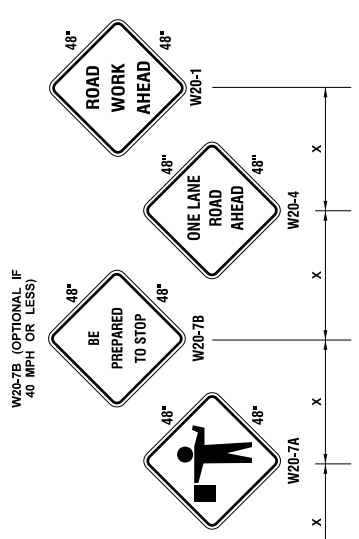
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BUFFER DATA											
LONGITUDINAL BUFFER SPACE = B			HOST VEHICLE WEIGHT > 22,000 lbs.								
SPEED (MPH)	25	30	35	40	45	50	55	60	65	70	
LENGTH (feet)	155	200	250	305	360	425	495	570	645	730	
TRANSPORTABLE ATTENUATOR ROLL AHEAD DISTANCE = R						HOST VEHICLE WEIGHT > 22,000 lbs.					
< 45 MPH	45-55 MPH	> 55 MPH	< 45 MPH	45-55 MPH	> 55 MPH	> 55 MPH	> 55 MPH	> 55 MPH	> 55 MPH	> 55 MPH	
100'	123'	172'	74'	100'	150'						
PROTECTIVE VEHICLE (WORK VEHICLE) = R						NO SPECIFIED DISTANCE REQUIRED					

SIGN SPACING = X (1)		
RURAL HIGHWAYS	60 / 65 MPH	800 ±
RURAL ROADS	45 / 55 MPH	500 ±
RURAL ROADS & URBAN ARTERIALS	35 / 40 MPH	350 ±
RURAL ROADS, URBAN ARTERIALS, RESIDENTIAL & BUSINESS DISTRICTS	25 / 30 MPH	200 ± (2)
URBAN STREETS	25 MPH OR LESS	100 ± (2)

(1) ALL SPACING MAY BE ADJUSTED TO ACCOMMODATE INTERSECTIONS AND DRIVEWAYS.
 (2) THIS SPACING MAY BE REDUCED IN URBAN AREAS TO FIT ROADWAY CONDITIONS.



CHANNELIZATION DEVICE SPACING (FEET)		
MPH	TAPER	TANGENT
50/65	10 TO 20	80
35/45	10 TO 20	60
25/30	10 TO 20	40

- NOTES**
1. ALL SIGNS ARE BLACK ON ORANGE.
 2. EXTENDING THE CHANNELIZING DEVICE TAPER ACROSS SHOULDER IS RECOMMENDED.
 3. NIGHT WORK REQUIRES ADDITIONAL ROADWAY LIGHTING AT FLAGGING STATIONS. SEE THE STANDARD SPECIFICATIONS FOR ADDITIONAL DETAILS.
 4. SEE SPECIAL PROVISIONS FOR WORK HOUR RESTRICTIONS.

ONE-LANE, TWO-WAY TRAFFIC CONTROL WITH FLAGGERS

NOT TO SCALE

- LEGEND**
- FLAGGING STATION
 - TEMPORARY SIGN LOCATION
 - CHANNELIZING DEVICES
 - PROTECTIVE VEHICLE

FILE NAME	S:\Design R_P\814-Standard3-Plan Sheet Library\01-Published PSL\TC Work Zone Traffic Control\TC-1 One Lane Two Way Traffic Control with Flaggers\TC-1.dgn
DATE	3/25/14 PM
DESIGNED BY	illdef
CHECKED BY	
PROJECT ENGINEER	
REGIONAL ADM.	
NO.	
REGION	WASH
STATE	
FED-AID PROJ.NO.	
JOB NUMBER	
CONTRACT NO.	
LOCATION NO.	
DATE	
BY	
REVISION	

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