

City of Tacoma
Tacoma Public Utilities
Tacoma Water

SPECIFICATION NO. TW 26 - 0014 F

GREEN RIVER FILTRATION FACILITY OZONE SYSTEM REPLACEMENT PROJECT

TABLE OF CONTENTS

REQUEST FOR BIDS
SUBMITTAL CHECKLIST
GENERAL PROVISIONS
SPECIAL NOTICE TO BIDDERS

PART I BID PROPOSAL AND CONTRACT FORMS

- 1 Bid Proposal
- 2 Signature Page
- 3 Bid Bond
- 4 Certification of Compliance with Wage Payment Statutes
- 5 State Responsibility and Reciprocal Bid Preference Information
- 6 Statement of Qualifications
- 7 Subcontractor List - Categories of Work
- 8 Substitution Request Form
- 9 Contract
- 10 Payment Bond to the City of Tacoma
- 11 Performance Bond to the City of Tacoma

PART II TECHNICAL SPECIFICATIONS

Part 1

Division 1	General Requirements
Division 2	Existing Conditions
Division 3	Concrete
Division 4	Not Used
Division 5	Metals
Division 6	Not Used
Division 7	Not Used
Division 8	Openings
Division 9	Finishes
Division 10 - 25	Not Used
Division 26	Electrical
Division 27 - 39	Not Used
Division 40	Process Interconnections
Division 41 - 43	Not Used
Division 44	Pollution and Waste Control Equipment
Division 45 - 49	Not Used

Part 2

Plans

Part 3

Veolia Power Supply Unit Procurement Proposal and
Control Panel Procurement Proposal

Appendix A – S&B Scope Letter

PART III STATE PREVAILING WAGE RATES AND INSURANCE REQUIREMENTS



City of Tacoma
Tacoma Water

REQUEST FOR BIDS TW26-0014F
GREEN RIVER FILTRATION FACILITY
OZONE SYSTEM REPLACEMENT PROJECT

Submittal Deadline: 11:00 a.m., Pacific Time, Tuesday, June 16, 2026

Submittals must be received by the City's Procurement and Payables Division by 11:00 a.m. Pacific Time.

For electronic submittals, the City of Tacoma will designate the time of receipt recorded by our email server, as the official time of receipt. This clock will be used as the official time of receipt of all parts of electronic bid submittals. Include the specification number in the subject line of your email. Your submittal must be sent as an attachment, links to your electronic submittal will not be accepted.

For in person submittals, the City of Tacoma will designate the time of receipt recorded by the timestamp located at the lobby security desk, as the official time of receipt. Include the specification number on the outside of the sealed envelope. Late submittals will be returned unopened and rejected as non-responsive.

Submittal Delivery: Sealed submittals will be received as follows:

By Email:

sendbid@tacoma.gov

Maximum email size, including attachments: 35 MB.
Multiple emails may be sent for each submittal.

Proposers submitting bid bonds electronically are required to submit hard copies to the City postmarked no later than the date of submittal.

Note: Email may pass through multiple servers before arriving at its destination. Please allow sufficient time for email delivery of submittals. Timely electronic delivery is at the risk of the supplier.

In Person:

Tacoma Public Utilities Administration Building North,
Main Floor, Lobby Security Desk
3628 South 35th Street
Tacoma, WA 98409
Monday – Friday 8:00 am to 4:30 pm

Bid Opening: Submittals must be received by the City's Procurement and Payables Division prior to 11:00 a.m. Pacific Time. Sealed submittals in response to a RFB will be opened Tuesday's at 11:15 AM by a purchasing representative and read aloud during a public bid opening held at the Tacoma Public Utilities Administrative Building North, 3628 S. 35th Street, Tacoma, WA 98409, conference room M-1, located on the main floor. They will also be held virtually Tuesday's at 11:15 AM. Attend a Zoom meeting [via this link](#) or call 1 (253) 215 8782 using meeting ID # 884 0268 0573, passcode # 070737.

Submittals in response to an RFP, RFQ or RFI will be recorded as received, but not read at bid opening. As soon as possible, after 1:00 PM, on the day of submittal deadline, preliminary results will be posted to www.TacomaPurchasing.org.

If you believe your submittal was sent timely and was not read at bid opening, please contact sendbid@tacoma.gov immediately.

Solicitation Documents: An electronic copy of the complete solicitation documents may be viewed and obtained at the City's plan distribution service provider, ARC, 632 Broadway, Tacoma, WA, or by going to <http://www.e-arc.com/location/tacoma>. Prospective bidders will be required to pay reproduction costs. A list of vendors registered for this solicitation is also available at their website.

Pre-Proposal Meeting: A pre-proposal meet will be held Thursday, May 21, 2026 from 9:00 a.m. to 10:30 a.m., in the Chinook Room at the Green River Filtration Facility located at 36525 SE Green River Headworks Road, Ravensdale, WA 98051. Note: Access is limited at this location. Please check in at the gate with current identification and proof of auto insurance.

Project Scope: Upgrade existing ozone system and components as detailed in the specifications. ***Proposers should take note that, due to the system integration requirements of this equipment, cybersecurity is required. See Section 3.6 of the City of Tacoma Insurance Requirements.***

Estimate: \$4,200,000 excluding taxes

Paid Sick Leave: The City of Tacoma requires all employers to provide paid sick leave in accordance with Washington State law.

Americans with Disabilities Act (ADA Information: The City of Tacoma, in accordance with Section 504 of the Rehabilitation Act (Section 504) and the Americans with Disabilities Act (ADA), commits to nondiscrimination on the basis of disability, in all of its programs and activities. Specification materials can be made available in an alternate format by emailing the contact listed below in the *Additional Information* section.

Title VI Information: “The City of Tacoma” in accordance with provisions of Title VI of the Civil Rights Act of 1964, (78 Stat. 252, 42 U.S.C. sections 2000d to 2000d-4) and the Regulations, hereby notifies all bidders that it will affirmatively ensure that in any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, national origin in consideration of award.

Additional Information: ***Any and all communication regarding this specification prior to bid opening will be coordinated through Brandon Snow, Senior Buyer, via email at bsnow@tacoma.gov. Questions and/or substitution requests must be received no later than 3:00 p.m., PST, Wednesday June 3, 2026. All substitution requests shall be submitted using the Substitution Request Form included in this specification. Substitution requests not received by the Senior Buyer will not be evaluated. An addendum listing any approvals will be issued. Substitutions not included in issued addenda are not approved.***

Protest Policy: City of Tacoma protest policy, located at www.tacomapurchasing.org, specifies procedures for protests submitted prior to and after submittal deadline.



Meeting sites are accessible to persons with disabilities. Reasonable accommodations for persons with disabilities can be arranged with 48 hours advance notice by calling 253-502-8468.

SUBMITTAL CHECK LIST

This checklist identifies items to be included with your submittal. Any submittal received without these required items may be deemed non-responsive and not be considered for award.

Submittals must be received by the City of Tacoma Purchasing Division by the date and time specified in the Request for Bids page.

The following items make up your submittal package:	
Bid Proposal	
Signature Page	
Bid Bond	
Certification of Compliance with Wage Payment Statutes	
State Responsibility and Reciprocal Bid Preference Information	
Statement of Qualifications	
Subcontractor List - Categories of Work	

After award, the following documents will be executed:	
Contract	
Performance and Payment Bonds	
Certificate of Insurance and related endorsements if required	

GENERAL PROVISIONS

(Revised October 8, 2024)

SECTION I - BIDDING REQUIREMENTS

SECTION I REQUIREMENTS ARE BINDING ON ALL RESPONDENTS.

1.01 USE AND COMPLETION OF CITY PROPOSAL SHEETS

A. Respondent's Proposal

Each Respondent must bid exactly as specified on the Proposal sheets. All proposals must remain open for acceptance by the City for a period of at least 60 calendar days from the date of opening of the bids.

B. Alterations of Proposals Not Allowed

Proposals that are incomplete or conditioned in any way contain alternatives or items not called for in the General Provisions and Specifications, or not in conformity with law may be rejected as being nonresponsive. The City cannot legally accept any proposal containing a substantial deviation from these Specifications.

C. Filling Out City Proposal Sheets

All proposals must be completed using the proposal sheets and forms included with this specification, and the prices must be stated in figures either written in ink or typewritten. No proposal having erasures or interlineations will be accepted unless initialed by the Respondent in ink.

1.02 CLARIFICATION OF PROPOSAL FOR RESPONDENT

If a prospective Respondent has any questions concerning any part of the Proposal, he/she may submit a written request for answer of his/her questions. Any interpretation of the Proposal will be made by an Addendum duly issued and mailed or delivered to each prospective Respondent. Such addendum must be acknowledged in the proposal. The City of Tacoma will not be responsible for any other explanation or interpretation of the bid documents.

1.03 RESPONDENT'S BOND OR CERTIFIED CHECK

Each bid for construction must be accompanied either by a certified or cashier's check for 5 percent of the total amount bid, including tax, payable to the City Treasurer, or an approved bid bond, by a surety company authorized to do business in the State of Washington, for 5 percent of the total amount bid. The person legally authorized to sign the bid must sign all bid bonds. The approved bid bond form attached to these Specifications should be used: no substantial variations from the language thereof will be accepted.

If a bid bond is used, the 5 percent may be shown either in dollars and cents, or the bid bond may be filled in as follows, "5 percent of the total amount of the accompanying proposal."

The check of the successful Respondent will be returned after award of the Contract, acceptance of the Payment and Performance Bond and City's receipt of the signed Contract. The checks of all other Respondents will be returned immediately upon the award of the Contract. Bid bonds will not be returned.

1.04 DELIVERY OF PROPOSALS TO THE CITY'S PURCHASING OFFICE

- A.** Proposal packages must be received by the City's Procurement and Payables Division in SAP Ariba (unless another form of delivery is stated), prior to the scheduled time and date stated in the Solicitation.
- B.** Supplier is solely responsible for timely delivery of its Submittal.
- C.** Submittals received after the time stated in the solicitation will not be accepted.
- D.** For purposes of determining whether a Submittal has been timely received in SAP Ariba, the City's Procurement and Payables Division will rely on the submittal clock in SAP Ariba.

1.05 LICENSES/PERMITS

- A.** Suppliers, if applicable, must have a Washington state business license at the time of Submittal and throughout the term of the Contract. Failure to include a Washington state business license may be grounds for rejection of the Submittal or cancellation of contract award. Information regarding Washington state business licenses may be obtained at <http://bls.dor.wa.gov>.
- B.** Upon award, it is the responsibility of the Supplier to register with the City of Tacoma's Tax and License Division, 733 South Market Street, Room 21, Tacoma, WA 98402-3768, 253-591-5252, https://www.cityoftacoma.org/government/city_departments/finance/tax_and_license/. Supplier shall obtain a business license as is required by Tacoma Municipal Code Subtitle 6C.20.
- C.** During the term of the Contract, Supplier, at its expense, shall obtain and keep in force any and all necessary licenses and permits.

1.06 CONTRACTOR'S STATE REGISTRATION NUMBER

Contractors for construction or public works construction are required to be licensed by the state. If the provisions of Chapter 18.27 of the Revised Code of Washington apply to the Respondent, then the Respondent's Washington State Contractor's Registration No. must accompany the bid.

1.07 BID IS NONCOLLUSIVE

The Respondent represents by the submission of the Proposal that the prices in this Bid are neither directly nor indirectly the result of any formal or informal agreement with another Respondent.

1.08 EVALUATION OF BID

A. Price, Experience, Delivery Time and Responsibility

In the evaluation of bids, the Respondent's experience, delivery time, quality of performance or product, conformance to the specifications and responsibility in performing other contracts (including satisfying all safety requirements) may be considered in addition to price. In addition, the bid evaluation factors set forth in City Code Section 1.06.262 may be considered by the City. Respondents who are inexperienced or who fail to properly perform other contracts may have their bids rejected for such cause.

B. Prequalified Electrical Contractor

Certain types of electrical construction require special expertise, experience, and prequalification of the Contractor (or subcontractor) by the City. In such cases, the Respondent must be prequalified or the Respondent must subcontract with a City prequalified electrical contractor for the specialty work.

C. Insertions of Material Conflicting with Specifications

Only material inserted by the Respondent to meet requirements of the Specifications will be considered. Any other material inserted by the Respondent will be disregarded as being nonresponsive and may be grounds for rejection of the Respondent's Proposal.

D. Correction of Ambiguities and Obvious Errors

The City reserves the right to correct obvious errors in the Respondent's proposal. In this regard, if the unit price does not compute to the extended total price, the unit price shall govern.

1.09 WITHDRAWAL OF BID

A. Prior to Bid Opening

Any Respondent may withdraw his/her Proposal prior to the scheduled bid opening time by delivering a written notice to the City's Procurement and Payables Office. The notice may be submitted in person or by mail; however, it must be received by the City's Procurement and Payables Office prior to the time of bid opening.

B. After Bid Opening

No Respondent will be permitted to withdraw his/her Proposal after the time of bid opening, as set forth in the Call for Bids, and before the actual award of the Contract, unless the award of Contract is delayed more than sixty (60) calendar days after the date set for bid opening. If a delay of more than 60 calendar days does occur, then the Respondent must submit written notice withdrawing his/her Proposal to the Purchasing Manager.

1.10 OPENING OF BIDS

At the time and place set for the opening of bids, all Proposals, unless previously withdrawn, will be publicly opened and read aloud, irrespective of any irregularities or informalities in such Proposal.

1.11 CITY COUNCIL/PUBLIC UTILITY BOARD FINAL DETERMINATION

The City Council or Public Utility Board of the City of Tacoma shall be the final judge as to which is the lowest and best bid in the interest of the City of Tacoma. The City reserves the right to reject any and all bids, waive minor deviations or informalities, and if necessary, call for new bids.

1.12 RESPONDENT'S REFUSAL TO ENTER INTO CONTRACT

Any Respondent who refuses to enter into a Contract after it has been awarded to the Respondent will be in breach of the agreement to enter the Contract and the Respondent's certified or cashier's check or bid bond shall be forfeited.

1.13 TAXES

A. Include In Proposal All Taxes

Respondent shall include in his/her Proposal all applicable local, city, state, and federal taxes. It is the Respondent's obligation to state on his/her Proposal sheet the correct percentage and total applicable Washington State and local sales tax. The total cost to the City including all applicable taxes may be the basis for determining the low Respondent.

B. Federal Excise Tax

The City of Tacoma is exempt from federal excise tax. Where applicable, the City shall furnish a Federal Excise Tax Exemption certificate.

C. City of Tacoma Business and Occupation Tax

Sub-Title 6A of the City of Tacoma Municipal Code (TMC) provides that transactions with the City of Tacoma, may be subject to the City of Tacoma's Business and Occupation Tax. It is the responsibility of the Respondent awarded the Contract to register with the City of Tacoma's Department of Tax and License, 733 South Market Street, Room 21, Tacoma, WA 98402-3768, telephone 253-591-5252. The City's Business and Occupation Tax amount shall not be shown separately but shall be included in the unit and/or lump sum prices bid.

1.14 FIRM PRICES/ESCALATION

Except as specifically allowed by the Special Provisions, only firm prices will be accepted.

1.15 AWARD

A. Construction and/or Labor Contracts

Unless specifically noted in the Special Provisions or Proposal sheets, all construction and/or labor contracts will be awarded to only one Respondent.

B. Supply/Equipment Contracts

The City reserves the right to award an equipment or supply contract for any or all items to one or more Respondents as the interests of the City will be best satisfied.

1.16 INCREASE OR DECREASE IN QUANTITIES

The City of Tacoma reserves the right to increase or decrease the quantities of any items under this Contract and pay according to the unit prices quoted in the Proposal (with no adjustments for anticipated profit).

1.17 EXTENSION OF CONTRACT

Contracts resulting from this specification shall be subject to extension by mutual agreement per the same prices, terms and conditions.

1.18 PAYMENT TERMS

- A. Prices will be considered as net 30 calendar days if no cash discount is shown. Payment discount periods of twenty (20) calendar days or more if offered in the submittal, will be considered in determining the apparent lowest responsible submittal. Discounts will be analyzed in context of their overall cumulative effect. Invoices will not be processed for payment nor will the period of cash discount commence until receipt of a properly completed invoice and until all invoiced items are received and satisfactory performance of the Contractor has been attained. If an adjustment in payment is necessary due to damage or dispute, the cash discount period shall commence on the date final approval for payment is authorized.
- B. ePayable/Credit Card Acceptance. Submittals offering ePayable/Credit card acceptance may be compared against submittals offering a prompt payment discount to evaluate the overall cumulative effect of the discount against the advantage to the City of the ePayable/Credit card acceptance, and may be considered in determining the apparent lowest responsible submittal.

1.19 PAYMENT METHOD – EPAYABLES – CREDIT CARD ACCEPTANCE – EFT/ACH ACCEPTANCE

- A. Payment methods include:
 - EPayables (Payment Plus). This is payment made via a virtual, single use VISA card number provided by the City's commercial card provider. Suppliers accepting this option will receive "due immediately" payment terms. Two options for acceptance are available to suppliers. Both are accompanied by an emailed advice containing complete payment details:
 - Straight-through processing (buyer initiated). Immediate, exact payments directly deposited to supplier accounts by the City's provider bank; the supplier does not need to know card account details.
 - Supplier retrieves card account through the secure, on-line portal provided via email notifications sent by the City's commercial card provider.
 - Credit card. Tacoma's VISA procurement card program is supported by standard bank credit suppliers and requires that merchants abide by the VISA merchant operating rules. It provides "due immediately" payment terms.
 - Suppliers must be PCI-DSS compliant (secure credit card data management) and federal FACTA (sensitive card data display) compliant.
 - Suppliers must be set up by their card processing equipment provider (merchant acquirer) as a minimum of a Level II merchant with the ability to pass along tax, shipping and merchant references information.
 - Electronic Funds Transfer (EFT) by Automated Clearing House (ACH). Standard terms are net 30 for this payment method.
 - Check or other cash equivalent. Standard terms are net 30 for this payment method.
- B. The City's preferred method of payment is by ePayables (Payment Plus) followed by credit card (aka procurement card). Suppliers may be required to have the capability of accepting the City's ePayables or credit card methods of payment. **The City of Tacoma will not accept price changes or pay additional fees when ePayables (Payment Plus) or credit card is used.**
- C. The City, in its sole discretion, will determine the method of payment for goods and/or services as part of the Contract.

1.20 COOPERATIVE PURCHASING

The Washington State Interlocal Cooperative Act RCW 39.34 provides that other governmental agencies may purchase goods and services on this solicitation or contract in accordance with the terms and prices indicated therein if all parties are agreeable.

1.21 PUBLIC DISCLOSURE: PROPRIETARY OR CONFIDENTIAL INFORMATION

- A. Respondent's Submittals, all documents and records comprising any Contract awarded to Respondent, and all other documents and records provided to the City by Respondent are deemed public records subject to disclosure under the Washington State Public Records Act, Chapter 42.56 RCW (Public Records Act). Thus, City may be required, upon request, to disclose the Contract and documents or records related to it unless an exemption under the Public Records Act or other laws applies. In the event CITY receives a request for such disclosure, determines in its legal judgment that no applicable exemption to disclosure applies; and Respondent has complied with the requirements to Respondent has complied with the requirements to mark records considered confidential or proprietary

as such requirements are stated below, City agrees to provide Respondent 10 days written notice of impending release. Should legal action thereafter be initiated by Respondent to enjoin or otherwise prevent such release, all expense of any such litigation shall be borne by Respondent, including any damages, attorneys' fees or costs awarded by reason of having opposed disclosure. City shall not be liable for any release where notice was provided and Respondent took no action to oppose the release of information.

B. If Respondent provides City with records or information that Respondent considers confidential or proprietary, Respondent must mark all applicable pages or sections of said record(s) as "Confidential" or "Proprietary." Further, in the case of records or information submitted in response to a Request for Proposals, an index must be provided indicating the affected pages or sections and locations of all such material identified Confidential or Proprietary. Information not included in the required index will not be reviewed for confidentiality or as proprietary before release. If Supplier fails to so mark or index Submittals and related records, then the City, upon request, may release said record(s) without the need to satisfy the requirements of subsection A above; and Respondent expressly waives its right to allege any kind of civil action or claim against the City pertaining to the release of said record(s). Submission of materials in response to City's Solicitation shall constitute assent by Respondent to the foregoing procedure and Respondent shall have no claim against the City on account of actions taken pursuant to such procedure.

1.22 FEDERAL AID PROJECTS

The City of Tacoma 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 insure that in any contract entered into pursuant to this advertisement, disadvantaged business enterprises as defined at 49 CFR, part 26, 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.

SECTION II - CONTRACT REQUIREMENTS

2.01 CONTRACTOR'S RESPONSIBILITY

A. Contract Documents

The Respondent to whom the Contract is awarded, hereinafter called the Contractor, shall enter into a Contract with the City of Tacoma, , within 10 days after receipt from the City of Tacoma of a properly prepared Contract. In addition, the Contractor will do all things required to promptly perform this Contract pursuant to the terms of this Contract. Certain contracts for supplies, goods or equipment may use the City Purchase Order in place of a formal contract document.

B. Surety Bonds

Except as modified by the Special Provisions, the Respondent to whom the Contract is awarded shall provide a payment and performance bond, including power of attorney, for 100 percent of the amount of his/her bid (including sales taxes), to insure complete performance of the Contract including the guarantee. The bonds must be executed by a surety company licensed to do business in the State of Washington. For a supply-type contract, a cashier's check or cash may be substituted for the bonds; however, this cash or cashier's check must remain with the City through the guarantee period and any interest on said amount shall accrue to the City.

C. Independent Contractor

Contractor is an independent contractor; no personnel furnished by the Contractor shall be deemed under any circumstances to be the agent or servant of the City. Contractor shall be fully responsible for all acts or omissions of Subcontractors and its and their suppliers and of persons employed by them, and shall be specifically responsible for sufficient and competent supervision and inspection to assure compliance in every respect with the Contract. There shall be no contractual relationship between any Subcontractors or supplier and the City arising out of or by virtue of this agreement. No provision of the Contract is intended or is to be construed to be for the benefit of any third party.

2.02 CONFLICTS IN SPECIFICATIONS

Anything mentioned in the Specifications and not shown on the Drawings and anything on the Drawings and not mentioned in the Specifications shall be of like effect and shall be understood to be shown and/or mentioned in both. In case of differences between Drawings and Specifications, the Specifications shall govern. In addition, in the event of any conflict between these General Provisions, the Special Provisions, the Technical Provisions and/or the Proposal pages, the following order of precedence shall control:

1. Proposal pages prevail if they conflict with the General, Special or Technical Provisions.
2. Special Provisions prevail if they conflict with the General Provisions and/or Technical Provisions.
3. Technical Provisions prevail if they are in conflict with the General Provisions.

In case of discrepancy of figures between Drawings, Specifications or both, the matter shall immediately be submitted to the Engineer for determination. Failure to submit the discrepancy issue to the Engineer shall result in the Contractor's actions being at his/her own risk and expense. The Engineer shall furnish from time to time such detailed drawings and other information as he/she may consider necessary.

2.03 INSPECTION

A. Of the Work

All materials furnished and work done shall be subject to inspection.

The Inspector administering the Contract shall at all times have access to the work wherever it is in progress or being performed, and the Contractor shall provide proper facilities for such access and inspection. Such inspection shall not relieve the Contractor of the responsibility of performing the work correctly, utilizing the best labor and materials in strict accordance with the Specifications of this Contract. All material or work approved and later found to be defective shall be replaced without cost to the City of Tacoma.

B. Inspector's Authority

The inspector shall have power to reject materials or workmanship which do not fulfill the requirements of these Specifications, but in case of dispute the Contractor may appeal to the Director or Superintendent, whose decision shall be final. The word "Director" means the Director of the City of Tacoma General Government department that is administering the contract. The word "Superintendent" means the Superintendent of the City of Tacoma, Department of Public Utilities Division that is administering the contract.

The Contract shall be carried out under the general control of the representative of the particular City Department or Division administering the Contract, who may exercise such control over the conduct of the work as may be necessary, in his or her opinion, to safeguard the interest of the City of Tacoma. The Contractor shall comply with all orders and instructions given by the representative of the particular Department or Division administering the Contract in accordance with the terms of the Contract.

Provided, that for the purposes of construction contracts, such control shall only apply (a) to the extent necessary to ensure compliance with the provisions of this contract, and (b) to the extent necessary to fulfill any nondelegable duty of the City for the benefit of third parties not engaged in promoting the activity of this contract.

Nothing herein contained, however, shall be taken to relieve the Contractor of his/her obligations or responsibilities under the Contract.

2.04 FEDERAL, STATE AND MUNICIPAL REGULATIONS

All federal, state, municipal and/or local regulations shall be satisfied in the performance of all portions of this Contract. The Contractor shall be solely responsible for all violations of the law from any cause in connection with work performed under this Contract.

2.05 INDEMNIFICATION

A. Indemnification

Contractor acknowledges that pursuant to the terms of this agreement, Contractor is solely and totally responsible for the safety of all persons and property in the performance of this Contract. To the greatest extent allowed by law, Contractor assumes the risk of all damages, loss, cost, penalties and expense and agrees to indemnify, defend and hold harmless the City of Tacoma, from and against any and all liability which may accrue to or be sustained by the City of Tacoma on account of any claim, suit or legal action made or brought against the City of Tacoma for the death of or injury to persons (including Contractor's or subcontractor's employees) or damage to property involving Contractor, or subcontractor(s) and their employees or agents, arising out of and in connection with or incident to the performance of the Contract including if the City is found to have a nondelegable duty to see that work is performed with requisite care, except for injuries or damages caused by the sole negligence of the City. In this regard, Contractor recognizes that Contractor is waiving immunity under industrial Insurance Law, Title 51 RCW. This indemnification extends to the officials, officers and employees of the City and also includes attorney's fees and the cost of establishing the right to indemnification hereunder in favor of the City of Tacoma. In addition, within the context of competitive bidding laws, it is agreed that this indemnification has been mutually negotiated. Provided however, this provision is intended to be applicable to the parties to this agreement and it shall not be interpreted to allow a Contractor's employee to have a claim or cause of action against Contractor.

B. Limitation of Liability for Primarily Supply-Type Contracts

In all contracts where the total cost of the supply of materials and/or equipment constitute at least 70 percent of the total contract price (as determined by the City), the City agrees that it will not hold the contractor, supplier or manufacturer liable for consequential damages for that part of the contract related to the manufacture and/or design of the equipment, materials or supplies.

2.06 CONTRACTOR'S INSURANCE

A. During the course and performance of a Contract, Contractor will provide proof and maintain the insurance coverage in the amounts and in the manner specified in the City of Tacoma Insurance Requirements as is applicable to the services, products, and deliverables provided under the Contract. The City of Tacoma Insurance Requirements document, if issued, is fully incorporated into the Contract by reference.

B. Failure by City to identify a deficiency in the insurance documentation provided by Contractor or failure of City to demand verification of coverage or compliance by Contractor with these insurance requirements shall not be construed as a waiver of Contractor's obligation to maintain such insurance.

2.07 ASSIGNMENT AND SUBLETTING OF CONTRACT

C. Assignment

The Contract shall not be assigned except with the consent of the Superintendent or his/her designee.

Requests for assignment of this contract must be in writing with the written consent of the surety, and the request must show the proposed person or organization to which the contract is assigned is capable, experienced and equipped to perform such work. The proposed substitute person or organization may be required to submit to the City information as to his/her experience, financial ability and give statements covering tools, equipment, organization, plans and methods to fulfill any portion of the Contract prior to approval of assignment.

D. Subletting

The Contract shall not be sublet except with the written consent of the Superintendent or his/her designee. In the event that a prequalified electrical contractor is necessary to perform certain portions of the work, such work may be subcontracted with a City prequalified electrical contractor for the type of work involved.

Requests for subletting of this Contract must be in writing with the written consent of the Surety, and the request must show the proposed person or organization to which the Contract is sublet is capable, experienced and equipped to perform such work. The proposed substitute person or organization may be required to submit to the City information as to his experience, financial ability and give statements covering tools, equipment, organization, plans and methods to fulfill any portion of the Contract prior to approval of subletting.

The written consent approving the subletting of the Contract shall not be construed to relieve the Contractor of his/her responsibility for the fulfillment of the Contract. The Subcontractor shall be considered to be the agent of the Contractor and the Contractor agrees to be responsible for all the materials, work and indebtedness incurred by the agent.

A subcontractor shall not sublet any portion of a subcontract for work with the City without the written consent of the City.

2.08 DELAY

E. Extension of Time

With the written approval of the Superintendent or his/her designee, the Contractor may be granted additional time for completion of the work required under this Contract, if, in the Superintendent's opinion the additional time requested arises from unavoidable delay.

F. Unavoidable Delay

Unavoidable delays in the prosecution of the work shall include only delays from causes beyond the control of the Contractor and which he/she could not have avoided by the exercise of due care, prudence, foresight and diligence. Delay caused by persons other than the Contractor, Subcontractors or their employees will be considered unavoidable delays insofar as they necessarily interfere with the Contractor's completion of the work, and such delays are not part of this Contract.

Unavoidable delay will not include delays caused by weather conditions, surveys, measurements, inspections and submitting plans to the Engineer of the particular Division involved in administering this Contract.

2.09 GUARANTEE

A. Guarantee for Construction, Labor or Services Contract

Neither the final certificate of payment or any provision in the Contract Documents, nor partial or entire occupancy of the premises by the City, shall constitute an acceptance of work not done in accordance with the Contract Documents or relieve the Contractor of liability in respect to any express warranties or responsibility for faulty materials or workmanship. The Contractor shall remedy any defects in the work and pay for any damage to other work resulting therefrom, which shall appear within a period of one year from the date of final acceptance of the work unless a longer period is specified. The City will give notice of observed defects with reasonable promptness.

If it has been discovered, before payment is required under the terms of the Contract, that there is a failure to comply with any of the terms and provisions of this Contract, the City has the right and may withhold payment.

In case of a failure of any part of the work, materials, labor and equipment furnished by the Contractor or to fully meet all of the requirements of the Contract, the Contractor shall make such changes as may be necessary to fully meet all of the specifications and requirements of this Contract. Such changes shall be made at the Contractor's sole cost and expense without delay and with the least practicable inconvenience to the City of Tacoma. Rejected material and equipment shall be removed from the City's property by and at the expense of the Contractor.

B. Guarantee for Supply Contracts

Unless a longer period is specified, the supplier and/or manufacturer of the supplies, materials and/or equipment furnished pursuant to this Contract agrees to correct any defect or failure of the supplies, materials and/or equipment which occurs within one year from the date of: (1) test energization if electrical or mechanical equipment; (2) commencement of use if supplies or materials, provided, however, said guarantee period shall not extend beyond eighteen months after date of receipt by the City. All of the costs (including shipping, dismantling and reinstallation) of repairs and/or corrections of defective or failed equipment, supplies and/or material is the responsibility of the supplier and/or manufacturer.

When the supplier is not the manufacturer of the item of equipment, supplier agrees to be responsible for this guarantee and supplier is not relieved by a manufacturer's guarantee.

C. Guarantee Period Extension

The Contract guarantee period shall be suspended from the time a significant defect is first documented by the City until the work or equipment is repaired or replaced by Contractor and accepted by the City. In addition, in the event less than ninety (90) days remain on the guarantee period (after recalculating), the guarantee period shall be extended to allow for at least ninety (90) days from the date the work or equipment is repaired or replaced and accepted by the City.

2.10 DEDUCTIONS FOR UNCORRECTED WORK

If the City of Tacoma deems it expedient to correct work not done in accordance with the terms of this Contract, an equitable deduction from the Contract price shall be made.

2.11 CITY OF TACOMA'S RIGHT TO TERMINATE CONTRACT

A. Termination for Convenience

1. Supplies. The City may terminate a Contract for supplies at any time upon prior written notice to Contractor. Upon the effective date of termination specified in such notice, and payment by the City, all conforming supplies, materials, or equipment previously furnished hereunder shall become its property.
2. Services. The City may terminate a Contract for services at any time, with or without cause, by giving 10-business day's written notice to Supplier. In the event of termination, all finished and unfinished work prepared by Supplier pursuant to the Contract shall be provided to the City. In the event City terminates the Contract due to the City's own reasons and without cause due to Supplier's actions or omissions, the City shall pay Supplier the amount due for actual work and services necessarily performed under the Contract up to the effective date of termination, not to exceed the total compensation set forth in the Contract.

B. Termination for Cause

1. The City may terminate a Contract for either services or supplies in the event of any material breach of any of the terms and conditions of the Contract if the Contractor's breach continues in effect after written notice of breach and 30 days to cure such breach and fails to cure such breach
2. Bankruptcy. If the Contractor should be adjudged as bankrupt, or makes a general assignment for the benefit of creditors, or a receiver should be appointed on account of his/her insolvency, or if he/she or any of his/her subcontractors should violate any of the provisions of the Contract, or if the work is not being properly and diligently performed, the City of Tacoma may serve written notice upon the Contractor and Surety, executing the Payment and Performance Bond, of its intention to terminate the Contract; such notice will contain the reasons for termination of the Contract, and unless within 10 days after the serving of such notice, such violation shall cease and an arrangement satisfactory to the City of Tacoma for correction thereof shall be made, the Contract shall, upon the expiration of said 10 days, cease and terminate and all rights of the Contractor hereunder shall be forfeited. In the event the Contract is terminated for cause, Contractor shall not be entitled to any lost profits resulting therefrom.
3. Notice. In the event of any such termination for cause, the City of Tacoma shall immediately send (by regular mail or other method) written notice thereof to the Surety and the Contractor. Upon such termination the Surety shall have the right to take over and perform the Contract, provided however, the Surety must provide written notice to the City of its intent to complete the work within 15 calendar days of its receipt of the original written notice (from the City) of the intent to terminate. Upon termination and if the Surety does not perform the work, the City of Tacoma may take over the work and prosecute the same to completion by any method it may deem advisable, for the account of and at the expense of the Contractor, and the Contractor and the Surety shall be liable to the City of Tacoma for all cost occasioned to the City of Tacoma thereby. The City of Tacoma may without liability for doing so, take possession of and utilize in completing the work, such materials, equipment, plant and other property belonging to the Contractor as may be on the site of the work and necessary therefore.

2.12 LIENS

In the event that there are any liens on file against the City of Tacoma, the City of Tacoma shall be entitled to withhold final or progress payments to the extent deemed necessary by the City of Tacoma to properly protect the outstanding lien claimants until proper releases have been filed with the City Clerk.

2.13 LEGAL DISPUTES

A. General

Washington law shall govern the interpretation of the Contract. The state or federal courts located in Pierce County Washington shall be the sole venue of any mediation, arbitration, or litigation arising out of the Contract.

Respondents providing submittals from outside the legal jurisdiction of the United States of America will be subject to Tacoma's City Attorney's Office (CAO) opinion as to the viability of possible litigation pursuant to a contract resulting from this Specification. If it is the opinion of the CAO that any possible litigation would be beyond reasonable cost and/or enforcement, the submittal may be excluded from evaluation.

B. Attorney Fees

For contracts up to \$250,000, which become the subject of litigation or arbitration, the substantially prevailing party may be entitled to reasonable attorney fees, as provided in RCW 39.04.240. Provided, however, the attorney fee hourly rate for the City of Tacoma's assistant city attorneys is agreed to be \$150 per hour or the same as the hourly rate for Contractor's legal counsel, whichever is greater.

2.14 DELIVERY

Prices must be quoted F.O.B. destination, freight prepaid and allowed with risk of loss during transit remaining with Contractor/Supplier (unless otherwise stated in these Specifications) to the designated address set forth in these Specifications.

Deliveries shall be between 9:00 a.m. and 3:30 p.m.; Monday through Friday only (except legal holidays of the City of Tacoma).

Legal holidays of the City of Tacoma are:

New Year's Day	January 1
Martin Luther King's Birthday	3rd Monday in January
Washington's Birthday	3rd Monday in February
Memorial Day	Last Monday in May
Juneteenth	June 19
Independence Day	July 4
Labor Day	1st Monday in September
Veteran's Day	November 11
Thanksgiving Day	4th Thursday of November
Day after Thanksgiving	4th Friday of November
Christmas Day	December 25

When any of these holidays occur on Saturday or Sunday, the preceding Friday or the following Monday, respectively, is a legal holiday for the City of Tacoma.

2.15 PACKING SLIPS AND INVOICES

A. Packing slips and shipping notices shall be sent to the specific City Division or Department receiving the item(s) at the address stated in City's Solicitation or as otherwise stated in the Contract and include complete description of items, contents of items if crated or cased, quantity, shipping point, carrier, bill of lading number and City of Tacoma purchase order.

B. Each invoice shall show City of Tacoma purchase order number, release number if applicable, quantity, unit of measure, item description, unit price and extended price for each line if applicable, services and deliverables provided if applicable. Line totals shall be summed to give a grand total to which sales tax shall be added, if applicable.

1. For transactions conducted in SAP Ariba, invoices shall be submitted through Ariba.
2. For invoices paid by ACH or by check, unless stated otherwise, invoices shall be electronically submitted by email with corresponding PO number listed in the subject line to accountspayable@cityoftacoma.org.

3. For invoices paid by credit card, invoices shall also display the last name of the cardholder and last four digits (only) of the card number (e.g., Jones/6311). Unless stated otherwise, invoices shall be electronically submitted by email with corresponding PO number listed in the subject line to (do not combine different POs into one invoice or charge) to pcardadmin@cityoftacoma.org.

2.16 APPROVED EQUALS

A. Unless an item is indicated as "No substitute", special brands, when named, are intended to describe the standard of quality, performance or use desired. Equal items will be considered by the City, provided that the respondent specifies the brand and model, and provides all descriptive literature, independent test results, product samples, local servicing and parts availability to enable the City to evaluate the proposed "equal".

B. The decision of the City as to what items are equal shall be final and conclusive. If the City elects to purchase a brand represented by the respondent to be an "equal", the City's acceptance of the item is conditioned on the City's inspection and testing after receipt. If, in the sole judgment of the City, the item is determined not to be an equal, the item shall be returned at the respondent's expense.

C. When a brand name or level of quality is not stated by the respondent, it is understood the offer is exactly as specified. If more than one brand name is specified, respondents must clearly indicate the brand and model/part number being bid.

2.17 ENTIRE AGREEMENT

This written contract represents the entire Agreement between the parties and supersedes any prior oral statements, discussions or understandings between the parties.

2.18 CODE OF ETHICS

The City's Code of Ethics, Chapter 1.46, Tacoma Municipal Code, provides ethical standards for City personnel and prohibits certain unethical conduct by others including respondents and contractors. Violation of the City's Code of Ethics will be grounds for termination of this contract.

2.19 FEDERAL FINANCIAL ASSISTANCE

If federal funds, including FEMA financial assistance to the City of Tacoma, will be used to fund, pay or reimburse all or a portion of the Contract, Contractor will comply with all applicable Federal law, regulations, executive orders, FEMA policies, procedures, and directives and the following clauses will be incorporated into the Contract:

A. EQUAL EMPLOYMENT OPPORTUNITY During the performance of this Contract, Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. Such action shall include, but not be limited to the following:

1. Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
2. The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.
3. The contractor will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other

employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the contractor's legal duty to furnish information.

4. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
5. The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.
6. The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.
7. In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.
8. The contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance:

Provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

B. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

1. Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.
2. Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (B)(1) of this section the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (B)(1) of this section, in the sum of \$27 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1) of this section.

3. Withholding for unpaid wages and liquidated damages. The City shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (B)(2) of this section.
4. Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (B)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (B)(1) through (4) of this section.

C. CLEAN AIR ACT

1. Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. § 7401 et seq.
2. Contractor agrees to report each violation to the City and understands and agrees that the City will, in turn, report each violation as required to assure notification to the Federal Emergency Management Agency, and the appropriate Environmental Protection Agency Regional Office.
3. Contractor agrees to include these requirements in each subcontract exceeding \$150,000 financed in whole or in part with Federal assistance provided by FEMA.

D. FEDERAL WATER POLLUTION CONTROL ACT

1. Contractor agrees to comply with all applicable standards, orders, or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1251 et seq.
2. Contractor agrees to report each violation to the City, understands, and agrees that the City will, in turn, report each violation as required to assure notification to the Federal Emergency Management Agency, and the appropriate Environmental Protection Agency Regional Office.
3. Contractor agrees to include these requirements in each subcontract exceeding \$150,000 financed in whole or in part with Federal assistance provided by FEMA.

E. DEBARMENT AND SUSPENSION

1. This contract is a covered transaction for purposes of 2 C.F.R. pt. 180 and 2 C.F.R. pt. 3000. As such, the contractor is required to verify that none of the contractor's principals (defined at 2 C.F.R. § 180.995) or its affiliates (defined at 2 C.F.R. § 180.905) are excluded (defined at 2 C.F.R. § 180.940) or disqualified (defined at 2 C.F.R. § 180.935).
2. Contractor must comply with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C, and must include a requirement to comply with these regulations in any lower tier covered transaction it enters into.
3. This certification is a material representation of fact relied upon by the City. If it is later determined that the contractor did not comply with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C, in addition to remedies available to (insert name of recipient/subrecipient/applicant), the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment.
4. Contractor agrees to comply with the requirements of 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C while this offer is valid and throughout the period of any contract that may arise from this offer. The bidder or proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions.

F. BYRD ANTI-LOBBYING AMENDMENT

1. Contractors who apply or bid for an award of \$100,000 or more shall file the required certification with City. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, officer or employee of Congress, or an employee of a Member of Congress in connection with obtaining any Federal contract, grant, or any other award covered by 31 U.S.C. § 1352. Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient who in turn will forward the certification(s) to the City.
2. If applicable, Contractor must sign and submit to the City the following certification:

APPENDIX A, 44 C.F.R. PART 18 – CERTIFICATION REGARDING LOBBYING

Certification for Contracts, Grants, Loans, and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
3. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

The Contractor, _____, certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of 31 U.S.C. Chap.38, Administrative Remedies for False Claims and Statements, apply to this certification and disclosure, if any.

Signature of Contractor's Authorized Official

Name and Title of Contractor's Authorized Official

Date

G. PROCUREMENT OF RECOVERED MATERIALS

1. In the performance of this contract, the Contractor shall make maximum use of products containing recovered materials that are EPA-designated items unless the product cannot be acquired:
 - a. Competitively within a timeframe providing for compliance with the contract performance schedule;
 - b. Meeting contract performance requirements; or
 - c. At a reasonable price.
2. Information about this requirement, along with the list of EPA- designated items, is available at EPA's Comprehensive Procurement Guidelines web site, <https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program>.
3. Contractor also agrees to comply with all other applicable requirements of Section 6002 of the Solid Waste Disposal Act.

[Section III is for contracts that involve construction and/or labor, and are not applicable to contracts solely for material/supply purchases.]

GENERAL PROVISIONS

SECTION III - CONSTRUCTION AND/OR LABOR CONTRACTS

SECTION III REQUIREMENTS APPLY ONLY TO CONSTRUCTION AND/OR LABOR CONTRACTS AND ARE IN ADDITION TO APPLICABLE REQUIREMENTS CONTAINED IN SECTION II CONTRACT REQUIREMENTS.

3.01 RESPONDENT'S DUTY TO EXAMINE

The Respondent agrees to be responsible for examining the site(s) and to have compared them with the Specifications and Contract Drawings, and to be satisfied as to the facilities and difficulties attending the execution of the proposed Contract (such as uncertainty of weather, floods, nature and condition of materials to be handled and all other conditions, obstacles and contingencies) before the delivery of his/her Proposal. No allowance will be subsequently made by the City on behalf of the Respondent by reason of any error or neglect on Respondent's part, for such uncertainties as aforesaid.

3.02 PERMITS

Except when modified by the Special Provisions, the Contractor shall procure and pay for all permits and licenses necessary for the completion of this Contract including those permits required by the City of Tacoma. The City will obtain county or state road crossing permits if required. In the event a necessary permit is not obtained, the Contractor will not be permitted to work on items subject to said permit and any delays caused thereby will not be subject to extra compensation or extensions.

3.03 NOTIFICATION OF OTHER GOVERNMENTAL AGENCIES AND UTILITIES WHEN UNDERGROUND WORK IS INVOLVED

The Contractor shall notify all other affected governmental agencies and utilities whenever underground work is done under the terms of this Contract. The Contractor is required to obtain permission of the appropriate public and private utilities and governmental agencies before performing underground work pursuant to the terms of this Contract. The Contractor is required to call "one call" at 1-800-424-5555 for all work involving excavation or digging more than 12 inches beneath ground or road surface.

The City may have indicated on the plans and specifications the existence of certain underground facilities that are known to the City department responsible for this Contract. It is the Contractor's responsibility to fully comply with the Underground Utility Locate Law, Chapter 19.122 RCW. If the site conditions are "changed or differing" as defined by RCW 19.122.040(l), the Contractor may pursue the party responsible for not properly marking or identifying the underground facility. The Contractor agrees not to file any claim or legal action against the City (department responsible for this Contract) for said "changed or differing" conditions unless said City department is solely responsible for the delay or damages that the Contractor may have incurred.

3.04 TRENCH EXCAVATION BID ITEM

In the event that "trench excavation" in excess of four feet requires a safety system pursuant to Washington State law and safety shoring, sloping, sheeting, or bracing is used, a separate bid item should be set forth in the Proposal for this work. If a separate bid item is not set forth in the Proposal pages, said installed safety system shall be paid at \$3.00 per lineal foot of trench, which unit price includes both sides of the trench.

3.05 SAFETY

A. General

The Contractor shall, at all times, exercise adequate precautions for the safety of all persons, including its employees and the employees of a Subcontractor, in the performance of this Contract and shall comply with all applicable provisions of federal, state, county and municipal safety laws and regulations. It is the Contractor's responsibility to furnish safety equipment or to contractually require Subcontractors to furnish adequate safety equipment relevant to their responsibilities.

The Contractor shall obtain the necessary line clearance from the inspector before performing any work in, above, below or across energized Light Division circuits.

The Inspector and/or Engineer may advise the Contractor and the Safety Officer of any safety violations. It is the Contractor's responsibility to make the necessary corrections. Failure to correct safety violations is a breach of this Contract and, as such, shall be grounds for an order from the Safety Officer, Inspector or Engineer to cease further work and remove from the job site until the condition is corrected. Time and wages lost due to such safety shutdowns shall not relieve the Contractor of any provisions of Section 3.14 of this Specification and shall be at the sole cost of the Contractor. The purpose of this authority to stop work is to enforce the contract and not to assume control except to the extent necessary to ensure compliance with the provisions of this contract.

Any of the above actions by employees of the City of Tacoma shall in no way relieve the Contractor of his/her responsibility to provide for the safety of all persons, including his/her employees.

B. Work Hazard Analysis Report

The Contractor will be required to complete a work hazard analysis report. This report shall outline how the Contractor proposes to satisfy all safety laws and regulations involved in performing the work. This report shall be completed and submitted to the City Safety Officer before the pre-construction conference. A copy of the report shall be maintained at the work site (accessible to the supervisor).

3.06 PROTECTION OF WORKERS AND PROPERTY

The Contractor shall erect and maintain good and sufficient guards, barricades and signals at all unsafe places at or near the work and shall, in all cases, maintain safe passageways at all road crossings, and crosswalks, and shall do all other things necessary to prevent accident or loss of any kind.

The Contractor shall protect from damage all utilities, improvements, and all other property that is likely to become displaced or damaged by the execution of the work under this Contract.

The Contractor is responsible for all roads and property damaged by his/her operations as shall be determined by the Engineer administering this Contract. The Contractor shall be responsible for repairing all damage to roads caused by his/her operations to the satisfaction of the particular governmental body having jurisdiction over the road.

3.07 CONTRACTOR - SUPERVISION AND CHARACTER OF EMPLOYEES

A. Superintendent to Supervise Contractor's Employees

The Contractor shall keep on his/her work, during its progress, a competent superintendent and any necessary assistants, all of whom must be satisfactory to the City of Tacoma. The Contractor's superintendent shall not be changed except with the consent of the City of Tacoma, unless the Contractor's superintendent proves to be unsatisfactory to the Contractor and ceases to be in his/her employ. The Contractor's superintendent shall represent the Contractor in his/her absence and all directions given to him/her shall be binding as if given to the Contractor directly. The Contractor shall give efficient supervision to the work, using his/her best skill and attention.

B. Character of Contractor's Employees

The Contractor shall employ only competent, skillful, faithful and orderly persons to do the work, and whenever the Engineer administering the Contract shall notify the Contractor in writing that any person on the work is, in his or her opinion, incompetent, unfaithful, disorderly or otherwise unsatisfactory, the Contractor shall forthwith discharge such persons from the work and shall not again employ him or her on this Contract.

3.08 CONTRACTOR'S COMPLIANCE WITH THE LAW

A. Hours of Labor

The Contractor and Subcontractors shall be bound by the provisions of RCW Chapter 49.28 (as amended) relating to hours of labor. Except as set forth in the Special Provisions, eight (8) hours in any calendar day shall constitute a day's work on a job performed under this Contract.

In the event that the work is not performed in accordance with this provision and in accordance with the laws of the State of Washington, then this Contract may be terminated by the City of Tacoma for the reason that the same is not performed in accordance with the public policy of the State of Washington as defined in said statutes.

B. Prevailing Wages

If federal, state, local, or any applicable law requires Supplier to pay prevailing wages in connection with a Contract, and Supplier is so notified by the City, then Supplier shall pay applicable prevailing wages.

If applicable, a Schedule of Prevailing Wage Rates and/or the current prevailing wage determination made by the Secretary of Labor for the locality or localities where the Contract will be performed is attached and made of part of the Contract by this reference. If prevailing wages do apply to the Contract, Supplier and its subcontractors shall:

1. Be bound by and perform all transactions regarding the Contract relating to prevailing wages and the usual fringe benefits in compliance with the provisions of Chapter 39.12 RCW, as amended, the Washington State Prevailing Wage Act and/or the Davis-Bacon Act (40 U.S.C. 3141- 3144, and 3146-3148) and the requirements of 29 C.F.R. pt. 5 as may be applicable, including the federal requirement to pay wages not less than once a week,
2. Ensure that no worker, laborer or mechanic employed in the performance of any part of the Contract shall be paid less than the prevailing rate of wage specified on that Schedule and/or specified in a wage determination made by the Secretary of Labor (unless specifically preempted by federal law, the higher of the Washington state prevailing wage or federal Davis-Bacon rate of wage must be paid)and Additionally, in compliance with applicable federal law, contractors are required to pay wages not less than once a week.
3. Immediately upon award of the Contract, contact the Department of Labor and Industries, Prevailing Wages section, Olympia, Washington and/or the federal Department of Labor, to obtain full information, forms and procedures relating to these matters. Per such procedures, a Statement of Intent to Pay Prevailing Wages and/or other or additional documentation required by applicable federal law, must be submitted by Contractor and its subcontractors to the City, in the manner requested by the City, prior to any payment by the City hereunder, and an Affidavit of Wages Paid and/or other or additional documentation required by federal law must be received or verified by the City prior to final Contract payment. In the event any dispute arises as to what are the prevailing rates of wages for work of a similar nature and such dispute cannot be adjusted by the parties in interest, including labor and management representatives, the matter shall be referred for arbitration to the Director of the State of Washington, Department of Labor and industries whose decision shall be final, conclusive and binding on all parties involved in the dispute.

3.09 COPELAND ANTI-KICKBACK ACT

For contracts subject to Davis Bacon Act the following clauses will be incorporated into the Contract:

A. Contractor. The contractor shall comply with 18 U.S.C. § 874, 40 U.S.C. § 3145, and the requirements of 29 C.F.R. pt. 3 as may be applicable, which are incorporated by reference into this contract.

B. Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clause above and such other clauses as FEMA may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all of these contract clauses.

C. Breach. A breach of the contract clauses above may be grounds for termination of the contract, and for debarment as a contractor and subcontractor as provided in 29 C.F.R. § 5.12.

3.10 CHANGES

A. In Plans or Quantities

The City of Tacoma, without invalidating this Contract, or any part of this Contract, may order extra work or make reasonable changes by altering, adding to or deducting from the materials, work and labor and the Contract sum will be adjusted accordingly. All such work and labor shall be executed under the conditions of the original Contract except that any claim for extension of time caused thereby shall be adjusted at the time of ordering such change. When work or bid items are deducted, reduced or eliminated, it is agreed that no payment will be made to Contractor for anticipated profit.

B. Extra Work

Any claim or order for extra materials, work and labor made necessary by alterations or additions to the plans or by other reasons for which no price is provided in this Contract, shall not be valid unless the Contractor and Engineer administering the Contract have agreed upon a price prior to commencing extra work, and the agreement has been signed by the Contractor and approved by the Superintendent or his/her designee, and approved by the payment and performance bond surety.

C. Extra Work - No Agreed Price

If it is impracticable to fix an increase in price definitely in advance, the order may fix a maximum price which shall not under any circumstances, be exceeded, and subject to such limitation, such alteration, modification, or extra shall be paid for at the actual necessary cost as determined by the City of Tacoma, which cost (including an allowance for profit) shall be determined as the sum of the following items (1) to (7) inclusive:

- (1) Labor, computed at regular wage scale, including premium on compensation insurance and charge for social security taxes, and other taxes, pertaining to labor; no charge for premium pay shall be allowed unless authorized by the Engineer administering the Contract;
- (2) The proportionate cost of premiums on comprehensive general liability and other insurance applicable to the extra work involved and required under this Contract;
- (3) Material, including sales taxes pertaining to materials;
- (4) Plant and equipment rental, to be agreed upon in writing before the work is begun; no charge for the cost of repairs to plant or equipment will be allowed;
- (5) Superintendence, general expense and profit computed at 20 percent of the total of paragraphs (1) to (4) inclusive;
- (6) The proportionate cost of premiums on bonds required by this Contract, computed by 1 1/2 percent of the total of paragraphs (1) to (5) inclusive.
- (7) The City of Tacoma reserves the right to furnish such materials as it may deem expedient, and no allowance will be made for profit thereon.

Whenever any extra work is in progress, for which the definite price has not been agreed on in advance, the Contractor shall each day, report to the Engineer the amount and cost of the labor and material used, and any other expense incurred in such extra work on the preceding day, and no claim for compensation for such extra work will be allowed unless such report shall have been made.

The above-described methods of determining the payment for work and materials shall not apply to the performance of any work or the furnishing of any material, which, in the judgment of the Engineer administering the Contract, may properly be classified under items for which prices are established in the Contract.

D. Claims for Extra Work

If the Contractor claims that any instructions by drawings or otherwise, involve extra cost under this Contract, he/she shall give the City of Tacoma written notice thereof within 30 days after receipt of such instruction, and in any event before proceeding to execute the work, except in an emergency endangering life or property, and the procedures governing the same shall be as provided for immediately above in this paragraph. The method in these paragraphs is the only method available to the Contractor for payment of claims for extra work performed under the terms of this Contract.

3.11 CLEANING UP

The Contractor shall at all times, at his/her own expense, keep the premises free from accumulation of waste materials or debris caused by any workers or the work, at the completion of the work the Contractor shall remove all his waste materials from and about the site and all his/her equipment, sanitary facilities and surplus materials. In the case of dispute, the City of Tacoma may remove the debris and charge the cost to the Contractor as the City of Tacoma shall determine to be just. All material that is deposited or placed elsewhere than in places designated or approved by the Engineer administering the Contract will not be paid for and the Contractor may be required to remove such material and deposit or place it where directed.

3.12 PROGRESS PAYMENT

Progress payments will be made up to the amount of ninety-five percent (95%) of the actual work completed as shall be determined by the Engineer administering the Contract.

The Contractor may request that an escrow account be established as permitted by law, in which event the Contractor will earn interest on the retained funds.

When the time for construction, services and/or installation will exceed thirty (30) days, the Contractor may request, by invoice, to be paid a progress payment based on percentage of work completed. The Engineer will review and approve the progress payment request on a monthly basis.

3.13 FINAL PAYMENT

The final payment of five percent (5%) of the Contract price shall be approved on final acceptance of the work under this Contract by the Superintendent or his/her designee. In addition, before final payment is made, the Contractor shall be required to:

- A. Provide a certificate from the Washington State Department of Revenue that all taxes due from the Contractor have been paid or are collectible in accordance with the provisions of Chapter 60.28 and Title 82 of the Revised Code of Washington;
- B. Provide the General Release to the City of Tacoma on the form set forth in these Contract documents;
- C. Provide a release of any outstanding liens that have been otherwise filed against any monies held or retained by the City of Tacoma;
- D. File with the City Director of Finance, and with the Director of the Washington State Department of Labor and Industries, on the state form to be provided, an affidavit of wages paid;
- E. File with the City Director of Finance, on the state form to be provided, a statement from the State of Washington, Department of Labor and Industries, certifying that the prevailing wage requirements have been satisfied.
- F. File with the City Director of Finance, on the state form to be provided, a statement of release from the Public Works Contracts Division of the State of Washington, Department of Labor and Industries, verifying that all industrial insurance and medical aid premiums have been paid.

If there is a fee assessed to the City for any certificate, release or other form required by law, the contractor agrees that the fee amount may be passed on to the Contractor and deducted from the monies paid to the Contractor.

3.14 FAILURE TO COMPLETE THE WORK ON TIME

Should the completion of the work required under the Contract be delayed beyond the expiration of the period herein set for the completion of said work, or such extension of said period as may be allowed by reason of unavoidable delays, there shall be deducted from the total Contract price of work, for each calendar day by which such completion shall be delayed beyond said period of such extension thereof the sum of \$300 or a sum of money as set forth hereinafter in these Specifications, as the amount of such deduction per calendar day.

Said sum shall be considered not as a penalty, but as liquidated damages, which the City will suffer by reason of the failure of the Contractor to perform and complete the work within the period, herein fixed or such extensions of said period as may be allowed by reason of unavoidable delays.

Any money due or to become due the Contractor may be retained by the City to cover said liquidated damages, and should such money not be sufficient to cover such damages, the City shall have the right to recover the balance from the Contractor or his/her Sureties.

The filing of any bid for the work herein contemplated shall constitute acknowledgment by the Respondent that he/she understands, agrees and has ascertained that the City will actually suffer damages to the amount hereinabove fixed for each and every calendar day during which the completion of the work herein required shall be delayed beyond the expiration of the period herein fixed for such completion or such extension of said period as may be allowed by reason of unavoidable delays.

3.15 CITY RESERVES RIGHT TO USE FACILITIES PRIOR TO ACCEPTANCE

The City of Tacoma hereby reserves the right to use the facilities herein contracted prior to final acceptance under this Contract. The use of said facilities, as mentioned herein, shall not be construed as a waiver or relinquishment of any rights that the City of Tacoma has under this Contract.

3.16 LIST OF SUBCONTRACTORS

Bid proposals for construction, alteration or repair of any building or other public works that may exceed \$1,000,000 including tax shall satisfy the following requirement: Respondent shall submit as part of the bid, the names of the subcontractors, with whom the respondent, if awarded the contract, will subcontract performance of the work of heating, ventilation and air conditioning, plumbing as described in chapter 18.106 RCW, and electrical as described in chapter 19.28 RCW, or to name itself for the work. The respondent shall not list more than one subcontractor for each category of work identified, unless subcontractors vary with bid alternates, in which case the respondent must indicate which subcontractor will be used for which alternate. Failure to comply with this provision or the naming of two or more subcontractors to perform the same work shall require the City (pursuant to state law RCW 39.30.060) to determine that respondent's bid is nonresponsive; therefore, the bid will be rejected.

**CITY OF TACOMA
FINANCE/PURCHASING DIVISION
SPECIAL NOTICE TO BIDDERS**

Public works and improvement projects for the City of Tacoma are subject to Washington state law and Tacoma Municipal Code, including, but not limited to the following:

I. STATE OF WASHINGTON

A. RESPONSIBILITY CRITERIA – STATE OF WASHINGTON

In order to be considered a responsible bidder the bidder must meet the following mandatory state responsibility criteria contained in RCW 39.04.350:

1. Have a current certificate of registration as a contractor in compliance with chapters 18.27 RCW, 18.106 RCW, 70.87 RCW, 19.28 RCW, which must have been in effect **at the time of bid submittal**;
2. Have a current Washington Unified Business Identifier (UBI) number;
3. If applicable:
 - a. Have Industrial Insurance (workers' compensation) coverage for the bidder's employees working in Washington, as required in Title 51 RCW;
 - b. Have a Washington Employment Security Department number, as required in Title 50 RCW;
 - c. Have a Washington Department of Revenue state excise tax registration number, as required in Title 82 RCW and;
4. Not be disqualified from bidding on any public works contract under RCW 39.06.010 (unlicensed or unregistered contractors) or 39.12.065(3) (prevailing wage).
5. Have received training on the requirements related to public works and prevailing wage under this chapter and chapter 39.12 RCW and must designate a person or persons to be trained on these requirements. The training must be provided by the department of labor and industries or by a training provider whose curriculum is approved by the department. Bidders that have completed three or more public works projects and have had a valid business license in Washington for three or more years are exempt from this subsection.

B. RECIPROCAL PREFERENCE FOR RESIDENT CONTRACTORS:

Effective March 30, 2012, RCW 39.04.380 imposes a reciprocal preference for resident contractors. Any bid received from a non-resident contractor from a state that provides an in-state percentage bidding preference is subject application of a comparable percentage disadvantage.

A non-resident contractor from a state that provides an in-state percentage bidding preference means a contractor that:

1. Is from a state that provides a percentage bid preference to its resident contractors bidding on public works projects, and
2. Does not have a physical office located in Washington at the time of bidding on the City of Tacoma public works project.

The state of residence for a non-resident contractor is the state in which the contractor was incorporated, or if not a corporation, the state in which the contractor's business entity was formed.

The City of Tacoma will evaluate all non-resident contractors for an out of state bidder preference. If the state of the non-resident contractor provides an in state contractor preference, a comparable percentage disadvantage will be applied to the non-resident contractor's bid prior to contract award. The responsive and lowest and best responsible bidder after application of any non-resident disadvantage will be awarded the contract.

The reciprocal preference evaluation does not apply to public works procured pursuant to RCW 39.04.155, RCW 39.04.280, federally funded competitive solicitations where such agencies prohibit the application of bid preferences, or any other procurement exempt from competitive bidding.

Bidders must provide the City of Tacoma with their state of incorporation or the state in which the business entity was formed and include whether the bidder has a physical office located in Washington.

The bidder shall submit documentation demonstrating compliance with above criteria on the enclosed State Responsibility and Reciprocal Bidder Information form.

C. SUBCONTRACTOR RESPONSIBILITY

1. The Contractor shall include the language of this subcontractor responsibility section in each of its first tier subcontracts, and shall require each of its subcontractors to include the same language of this section in each of their subcontracts, adjusting only as necessary the terms used for the contracting parties. The requirements of this section apply to all subcontractors regardless of tier.
2. At the time of subcontract execution, the Contractor shall verify that each of its first tier subcontractors meets the following bidder responsibility criteria:
 - a. Have a current certificate of registration as a contractor in compliance with chapter 18.27 RCW, which must have been in effect at the time of subcontract bid submittal;
 - b. Have a current Washington Unified Business Identifier (UBI) number;
 - c. If applicable, have:
 - a. Have Industrial Insurance (workers' compensation) coverage for the bidder's employees working in Washington, as required in Title 51 RCW;
 - b. A Washington Employment Security Department number, as required in Title 50 RCW;
 - c. A Washington Department of Revenue state excise tax registration number, as required in Title 82 RCW;
 - d. An electrical contractor license, if required by Chapter 19.28 RCW;
 - e. An elevator contractor license, if required by Chapter 70.87 RCW and;
3. Not be disqualified from bidding on any public works contract under RCW 39.06.010 (unlicensed or unregistered contractors) or 39.12.065(3) (prevailing wage).

II. CITY OF TACOMA

A. SUPPLEMENTAL RESPONSIBILITY CRITERIA – CITY OF TACOMA:

In order to be considered a responsible bidder, the prospective bidder shall have all of the following qualifications set forth in Tacoma Municipal Code 1.06.262:

1. Adequate financial resources or the ability to secure such resources;
2. The necessary experience, stability, organization and technical qualifications to perform the proposed contract;
3. The ability to comply with the required performance schedule, taking into consideration all existing business commitments;
4. A satisfactory record of performance, integrity, judgment and skills; and
5. Be otherwise qualified and eligible to receive an award under applicable laws and regulations.
 - a. Bidder Responsibility. Bidders shall not be in violation of 39.04.350 RCW Bidder Responsibility Criteria - Supplemental Criteria.

In addition to the mandatory bidder responsibility criteria listed immediately above, the City may, in addition to price, consider any or all of the following criteria contained in Tacoma Municipal Code Chapter 1.06.262 in determining bidder responsibility:

1. The ability, capacity, experience, stability, technical qualifications and skill of the respondent to perform the contract;
2. Whether the respondent can perform the contract within the time specified, without delay or interference;
3. Integrity, reputation, character, judgment, experience, and efficiency of the respondents, including past compliance with the City's Ethics Code;
4. Quality of performance of previous contracts;
5. Previous and existing compliance with laws and ordinances relating to contracts or services;
6. Sufficiency of the respondent's financial resources;
7. Quality, availability, and adaptability of the supplies, purchased services or public works to the particular use required;
8. Ability of the respondent to provide future maintenance and service on a timely basis;
9. Payment terms and prompt pay discounts;
10. The number and scope of conditions attached to the submittal;
11. Compliance with all applicable City requirements, including but not limited to the City's Ethics Code and its Equity in Contracting and Local Employment and Apprenticeship Training programs;
12. Other qualification criteria set forth in the specification or advertisement that the appropriate department or division head determines to be in the best interests of the City.

The City may require bidders to furnish information, sworn or certified to be true, to demonstrate compliance with the City responsibility criteria set forth above. If the city manager or director of utilities is not satisfied with the sufficiency of the information provided, or if the prospective respondent does not substantially meet all responsibility requirements, any submittal from such respondent must be disregarded.

B. ADDITIONAL SUPPLEMENTAL CRITERIA

Pursuant to RCW 39.04.350(3), the Bidder shall demonstrate to the satisfaction of the City of Tacoma that the Bidder is qualified to perform the work under this Contract and therefore are a responsible Bidder. To be responsible, the Bidder, must demonstrate an appropriate level of experience, technical competence and successful past performance of work. The information in the Statement of Qualifications Form will assist the City of Tacoma in making such determination.

C. MODIFICATIONS TO SUPPLEMENTAL CRITERIA

Potential bidders may request modifications to the City's **supplemental criteria** by submitting a written request to the Purchasing Division via email to sendbid@tacoma.gov no later than 5:00 p.m. Pacific Time, three days prior to the submittal deadline. Please include the Specification No. and Title when submitting such requests. Requests must include justification for why certain criteria should be modified. Requests received after this date and time will not be considered.

The City will respond to a timely submitted request prior to the bid opening date. Changes to the supplemental criteria, if warranted, will be issued by addendum to the solicitation documents and posted to the City's website for the attention of all prospective bidders.

D. DETERMINATION OF BIDDER RESPONSIBILITY

If the City determines the bidder does not meet the criteria above and is therefore not a responsible bidder, the City shall notify the bidder in writing with the reasons for its determination. If the bidder disagrees, the bidder may appeal the determination in a manner consistent with the City's Protest Policy. Appeals are coordinated by the Purchasing Division heard by the Procurement and Payables Division manager for contracts less than or equal to \$500,000 and by Contracts and Awards Board for contracts greater than \$500,000.

PART I

BID PROPOSAL AND CONTRACT FORMS

BID PROPOSAL

TW26-0014F Green River Filtration Facility Ozone System Replacement Project					
Item	Description	Units	Quantity	Unit Price	Total Price
1	Lump Sum Amount to complete all work described in the TW26-0014F bid documents.	LS	1	\$_____	\$_____
2	Work performed by the Process and Instrumentation Control (PIC) Integrator, S&B, Inc., as described in Appendix A	LS	1	<u>\$1,397,760.00</u>	<u>\$1,397,760.00</u>
3	Minor Change, including allowance for minor wiring replacement.	LS	1	<u>\$ 150,000.00</u>	<u>\$ 150,000.00</u>
Base Bid Subtotal (Items 1-3)					\$_____
Sales Tax - 8.9%					\$_____
Total Base Bid					\$_____

SIGNATURE PAGE

CITY OF TACOMA TACOMA PUBLIC UTILITIES / TACOMA WATER

All submittals must be in ink or typewritten, executed by a duly authorized officer or representative of the bidding/proposing entity, and received and time stamped as directed in the **Request for Bids page near the beginning of the specification**. If the bidder/proposer is a subsidiary or doing business on behalf of another entity, so state, and provide the firm name under which business is hereby transacted.

REQUEST FOR BIDS SPECIFICATION NO. TW26-0014F Green River Filtration Facility Ozone System Replacement Project

The undersigned bidder/proposer hereby agrees to execute the proposed contract and furnish all materials, labor, tools, equipment and all other facilities and services in accordance with these specifications.

The bidder/proposer agrees, by submitting a bid/proposal under these specifications, that in the event any litigation should arise concerning the submission of bids/proposals or the award of contract under this specification, Request for Bids, Request for Proposals or Request for Qualifications, the venue of such action or litigation shall be in the Superior Court of the State of Washington, in and for the County of Pierce.

Non-Collusion Declaration

The undersigned bidder/proposer hereby certifies under penalty of perjury that this bid/proposal is genuine and not a sham or collusive bid/proposal, or made in the interests or on behalf of any person or entity not herein named; and that said bidder/proposer has not directly or indirectly induced or solicited any contractor or supplier on the above work to put in a sham bid/proposal or any person or entity to refrain from submitting a bid/proposal; and that said bidder/proposer has not, in any manner, sought by collusion to secure to itself an advantage over any other contractor(s) or person(s).

Bidder/Proposer's Registered Name

Signature of Person Authorized to Enter Date
into Contracts for Bidder/Proposer

Address

Printed Name and Title

City, State, Zip

(Area Code) Telephone Number / Fax Number

Authorized Signatory E-Mail Address

State Business License Number
in WA, also known as UBI (Unified Business Identifier) Number

E.I.No. / Federal Social Security Number Used on Quarterly
Federal Tax Return, U.S. Treasury Dept. Form 941

State Contractor's License Number
(See Ch. 18.27, R.C.W.)

E-Mail Address for Communications

Addendum acknowledgement #1_____ #2_____ #3_____ #4_____ #5_____

THIS PAGE MUST BE SIGNED AND RETURNED WITH SUBMITTAL.

Herewith find deposit in the form of a cashier's check in the amount of \$_____ which amount is not less than 5-percent of the total bid.

SIGN HERE _____

BID BOND

KNOW ALL MEN BY THESE PRESENTS:

That we, _____, as Principal, and _____, as Surety, are held and firmly bound unto the City of Tacoma, as Obligee, in the penal sum of _____ dollars, for the payment of which the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, by these presents.

The condition of this obligation is such that if the Obligee shall make any award to the Principal for

according to the terms of the proposal or bid made by the Principal therefor, and the Principal shall duly make and enter into a contract with the Obligee in accordance with the terms of said proposal or bid and award and shall give bond for faithful performance thereof, with Surety or Sureties approved by the Obligee; or if the Principal shall, in case of failure to do so, pay and forfeit to the Obligee the penal amount of the deposit specified in the call for bids, then this obligation shall be null and void; otherwise it shall be and remain in full force and effect and the Surety shall forthwith pay and forfeit to the Obligee, as penalty and liquidated damages, the amount of this bond.

SIGNED, SEALED AND DATED THIS _____ DAY OF _____, 20_____.

PRINCIPAL:

SURETY:

_____, 20_____

Received return of deposit in the sum of \$ _____



City of Tacoma

Certification of Compliance with Wage Payment Statutes

The bidder hereby certifies that, within the three-year period immediately preceding the bid solicitation date (**May 19, 2026**), that the bidder is not a “willful” violator, as defined in RCW 49.48.082, of any provision of chapters 49.46, 49.48, or 49.52 RCW, as 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.

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

Bidder

Signature of Authorized Official*

Printed Name

Title

Date

City

State

Check One:

Individual ☐

Partnership ☐

Joint Venture ☐

Corporation ☐

State of Incorporation, or if not a corporation, the state where business entity was formed:

If a co-partnership, give firm name under which business is transacted:

** If a corporation, proposal must be executed in the corporate name by the president or vice-president (or any other corporate officer accompanied by evidence of authority to sign). If a co-partnership, proposal must be executed by a partner.*

Specification No. _____

Name of Bidder: _____

State Responsibility and Reciprocal Bid Preference Information

Certificate of registration as a contractor
(Must be in effect at the time of bid submittal):

Number: _____

Effective Date: _____

Expiration Date: _____

Current Washington Unified Business Identifier
(UBI) Number:

Number: _____

Do you have industrial insurance (workers' compensation)
Coverage nor your employees working in Washington?

☐ Yes ☐ No
☐ Not Applicable

Washington Employment Security Department Number

Number: _____

☐ Not Applicable

Washington Department of Revenue state excise tax
Registration number:

Number: _____

☐ Not Applicable

Have you been disqualified from bidding any public
works contracts under RCW 39.06.010 or 39.12.065(3)?

☐ Yes ☐ No
If yes, provide an explanation of your
disqualification on a separate page.

Do you have a physical office located in the state of
Washington?

☐ Yes ☐ No

If incorporated, in what state were you incorporated?

State: _____ ☐ Not Incorporated

If not incorporated, in what state was your business
entity formed?

State: _____

Have you completed the training required by RCW
39.04.350, or are you on the list of exempt businesses
maintained by the Department of Labor and Industries?

☐ Yes ☐ No

**STATEMENT OF QUALIFICATIONS
FOR CONTRACTORS**

This form shall be completed in its entirety and submitted with the bid. **Failure to submit and meet the requirements will be grounds for rejection of the bid.**

Pursuant to RCW 39.04.350(3)(a) and TMC 1.06.262(C) The City of Tacoma will be the sole judge in determining if the prospective contractor meets the minimum experience requirements.

- 1) Have completed at least two (2) water or wastewater plant remodel projects of \$4,000,000 or more in the past five years. One (1) of the projects must include work with Ozone Generators or Ozone Systems.

Contractor:

Name: _____

Address: _____

Phone: _____ Contact Person: _____

Project Experience

#1 Project Name: _____

Owner: _____ Contact Person/Phone No: _____

Description of Work: _____

Completion Date: _____

#2 Project Name: _____

Owner: _____ Contact Person/Phone No: _____

Description of Work: _____

Completion Date: _____

Subcontractor Categories of Work

Supplier Name: _____

Spec Number: _____

Project Name: _____

Subcontractor(s) that are proposed to perform the work of: HVAC (heating, ventilation and air conditioning), and/or plumbing, as described in Chapter 18.106 RCW, and/or electrical as described in Chapter 19.28 RCW must be listed below. Proof of License must also be provided. **This information must be submitted with the bid proposal.**

Subcontractor(s) that are proposed to perform the work of structural steel installation and/or rebar installation must be listed below. **This information must be submitted with the bid proposal or within forty-eight hours of the published bid submittal time via email to sendbid@tacoma.gov**

Failure to list subcontractors or naming more than one subcontractor to perform the same work will result in a bid being non-responsive. Contractors self-performing must list themselves below if licensed to perform the work including their specialty license numbers if applicable. General contractor license numbers given for specialty work may result in a non-responsive bid. The work to be performed is to be listed below the subcontractor(s) name.

Subcontractor Name:
(and License Number, if required)

Work to be performed:

Subcontractor Name:
(and License Number, if required)

Work to be performed:

Subcontractor Name:
(and License Number, if required)

Work to be performed:

Subcontractor Name:
(and License Number, if required)

Work to be performed:

Subcontractor Name:
(and License Number, if required)

Work to be performed:

TACOMA WATER SUBSTITUTION REQUEST FORM

This request shall be submitted to the engineer listed below no later than 3:00 p.m., PST, Wednesday, June 3, 2026 where "or equal" options will be considered. Substitution requests not received by the engineer will not be considered.

ATTN: Mike Gorenson P.E.

Date: _____

PROJECT: TW26-0014F Green River Filtration Facility Ozone System Replacement Project Transmittal No. _____
(Specification/Name/Contract No., if applicable)

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

Specification Section: _____

Specified Item: _____

Proposed Substitution: _____

NOTES: Attach complete technical data, including laboratory tests and samples as applicable.

Provide a detailed comparison of the significant qualities (size, weight, durability, performance and similar characteristics, including visual effect, where applicable) for the proposed substitution in comparison with the original requirements.

List completely, installation changes, changes to drawings, and specifications required by the proposal.

FILL IN BLANKS BELOW:

A. Does substitution require change in drawing dimensions? ☐ Yes ☐ No

If yes, provide detail: _____

B. Will undersigned pay for resulting building design changes including engineering/detailing costs? ☐ Yes ☐ No

C. What effect does substitution have on other trades?

D. Difference between proposed substitution and specified item?

E. Manufacturer's guarantees of proposed and specified items are? ☐ Same ☐ Different*

*Explain differences on attachment(s).

F. Are maintenance/service parts locally (within 50 miles) available for proposed substitution? ☐ Yes ☐ No

G. Will the proposed substitution have any effect on compliance with applicable codes? ☐ Yes ☐ No

If yes, explain: _____

H. Name, address, and current phone number of the Project Lead for one (1) similar project where the proposed product was used, along with the Project name and date of installation:

I. Contract completion date is? _____ ☐ Same ☐ Different*

*Explain differences on attachment(s).

TACOMA WATER SUBSTITUTION REQUEST FORM

This request shall be submitted to the engineer listed below no later than 3:00 p.m., PST, Wednesday, June 3, 2026 where "or equal" options will be considered. Substitution requests not received by the engineer will not be considered.

Undersigned attests function and quality equivalent or superior to specified item and waives their rights to additional payment and time which may subsequently be necessitated by failure of the substitution to perform adequately, and for the required work to make corrections thereof.

SUBMITTED BY:

Name

Firm

Address

City, State, Zip

Phone No.

Signature

Date

FOR USE BY TACOMA WATER

☐ Accepted

☐ Accepted as Noted

☐ Not Accepted

☐ Received Too Late

By: Mike Gorenson P.E.

(Project Lead/Manager)

Signature: _____

Date: _____

REMARKS:

CONTRACT

This Contract is made and entered into effective as of [INSERT EFFECTIVE DATE Contract date should match date of award letter and month should be formally spelled out] ("Effective Date") by and between the City of Tacoma, a Municipal Corporation of the State of Washington ("City"), and [INSERT supplier name as it appears in Ariba, including dbas or trade names] ("Contractor").

That in consideration of the mutual promises and obligations hereinafter set forth the Parties hereto agree as follows:

- I. Contractor shall fully execute and diligently and completely perform all work and provide all services and deliverables described herein and in the items listed below each of which are fully incorporated herein and which collectively are referred to as "Contract Documents":

1. Specification No. [INSERT Spec Number] and [Spec Title] together with all authorized addenda.
2. Contractor's submittal dated [Enter Submittal Date] submitted in response to Specification No. [Spec Number] and [Spec Title].
3. Describe with specific detail and list separately any other documents that will make up the contract (fee schedule, work schedule, authorized personnel, agreed upon exceptions, Exhibits etc.) or any other additional items mutually intended to be binding upon the parties.

[If there are no additional contract documents listed in #3 highlighted in the box above, delete the above highlighted sentence, and delete all of Section III below]

- II. If federal funds will be used to fund, pay or reimburse all or a portion of the services or deliverables provided under the Contract, the terms and conditions set forth at Addendum A are incorporated into and made part of this Contract and CONTRACTOR will comply with all applicable provisions of Addendum A and with all applicable federal laws, regulations, executive orders, policies, procedures, and directives in the performance of this Contract.

If CONTRACTOR's receipt of federal funds under this Contract is as a sub-recipient, a fully completed Addendum B, "Sub-recipient Information and Requirements" is incorporated into and made part of this Contract.

If this Contract is funded in whole or in part by any Federally-assisted program of the U.S. Department of Transportation, the requirements of Appendices A and E of the USDOT Title VI Assurances, set forth in Addendum C are incorporated into and made part of this Contract.

- III. In the event of a conflict or inconsistency between the terms and conditions contained in this document entitled Contract and any terms and conditions contained the above referenced Contract Documents the following order of precedence applies with the first listed item being the most controlling and the last listed item the least controlling:

1. Contract, inclusive of Addenda A and B and Insurance Requirements.
2. List remaining Contract Documents in applicable controlling order.

[If the only contract documents are the specification and submittal and insurance requirement and no exceptions are taken in the submittal, Section III should be deleted]

- IV. The Contract terminates on [INSERT Termination Date], and may be renewed for [Renewal Term] [Complete as needed and as stated in the specification]
- V. The total price to be paid by City for Contractor's full and complete performance hereunder, including during any authorized renewal terms, may not exceed: \$[INSERT TOTAL COMPENSATION NOT TO EXCEED AMOUNT], plus any applicable taxes. [If Contract is being used as Citywide, no NTE, but individual purchases of \$500k or more need governing body approval]
- VI. Contractor agrees to accept as full payment hereunder the amounts specified herein and in Contract Documents, and the City agrees to make payments at the times and in the manner and upon the terms and conditions specified. Except as may be otherwise provided herein or in Contract Documents

Contractor shall provide and bear the expense of all equipment, work and labor of any sort whatsoever that may be required for the transfer of materials and for constructing and completing the work and providing the services and deliverables required by this Contract.

- VII. The City's preferred method of payment is by ePayables (Payment Plus), followed by credit card (aka procurement card), then Electronic Funds Transfer (EFT) by Automated Clearing House (ACH), then check or other cash equivalent. CONTRACTOR may be required to have the capability of accepting the City's ePayables or credit card methods of payment. The City, in its sole discretion, will determine the method of payment for this Contract.
- VIII. Failure by City to identify a deficiency in the insurance documentation provided by Contractor or failure of City to demand verification of coverage or compliance by Contractor with the insurance requirements contained in the Contract Documents shall not be construed as a waiver of Contractor's obligation to maintain such insurance.
- IX. Contractor shall comply with all federal, state, municipal, and/or local laws and regulations in the performance of all terms and conditions of the Contract. Contractor shall be solely responsible for all violations of the law from any cause in connection with its performance of work under the Contract.
- X. Contractor and for its heirs, executors, administrators, successors, and assigns, does hereby agree to the full performance of all the requirements contained herein and in Contract Documents.

It is further provided that no liability shall attach to City by reason of entering into this Contract, except as expressly provided herein.

IN WITNESS WHEREOF, the Parties hereto have accepted and executed this Contract, as of the Effective Date stated above, which shall be Effective Date for bonding purposes as applicable. The undersigned Contractor representative, by signature below, represents and warrants they are duly authorized to execute this legally binding Contract for and on behalf of Contractor and further represents and warrants that Contractor is not suspended, debarred, or otherwise disqualified under federal, state, or local law from participating in this Contract.

CITY OF TACOMA:
Signature:

CONTRACTOR:
Signature:

Name:

Title:

Name:

Title:

(City of Tacoma use only - blank lines are intentional)

Director of Finance: _____

Deputy/City Attorney (approved as to form): _____

Approved By: _____

Approved By: _____

Approved By: _____

Approved By: _____

Approved By: _____

Approved By: _____

**ADDENDUM A
FEDERAL FUNDING**

1. Termination for Breach

CITY may terminate this Contract in the event of any material breach of any of the terms and conditions of this Contract if CONTRACTOR's breach continues in effect after written notice of breach and 30 days to cure such breach and fails to cure such breach.

2. Prevailing Wages

- A. If federal, state, local, or any applicable law requires CONTRACTOR to pay prevailing wages in connection with this Contract, and CONTRACTOR is so notified by the CITY, then CONTRACTOR shall pay applicable prevailing wages and otherwise comply with the Washington State Prevailing Wage Act (RCW 39.12) in the performance of this Contract.
- B. If applicable, a Schedule of Prevailing Wage Rates and/or the current prevailing wage determination made by the Secretary of Labor for the locality or localities where the Contract will be performed is made of part of the Contract by this reference. If prevailing wages apply to the Contract, CONTRACTOR and its subcontractors shall:
 - i. Be bound by and perform all transactions regarding the Contract relating to prevailing wages and the usual fringe benefits in compliance with the provisions of Chapter 39.12 RCW, as amended, the Washington State Prevailing Wage Act and/or the Davis-Bacon Act (40 U.S.C. 3141- 3144, and 3146-3148) and the requirements of 29 C.F.R. pt. 5 as may be applicable, including the federal requirement to pay wages not less than once a week.
 - ii. Ensure that no worker, laborer or mechanic employed in the performance of any part of the Contract shall be paid less than the prevailing rate of wage specified on that Schedule and/or specified in a wage determination made by the Secretary of Labor (unless specifically preempted by federal law, the higher of the Washington state prevailing wage or federal Davis-Bacon rate of wage must be paid.
 - iii. Immediately upon award of the Contract, contact the Department of Labor and Industries, Prevailing Wages section, Olympia, Washington and/or the federal Department of Labor, to obtain full information, forms and procedures relating to these matters. Per such procedures, a Statement of Intent to Pay Prevailing Wages and/or other or additional documentation required by applicable federal law, must be submitted by CONTRACTOR and its subcontractors to the CITY, in the manner requested by the CITY, prior to any payment by the CITY hereunder, and an Affidavit of Wages Paid and/or other or additional documentation required by federal law must be received or verified by the CITY prior to final Contract payment.

3. COPELAND ANTI-KICKBACK ACT

For Contracts subject to Davis Bacon Act the following clauses will be incorporated into the Contract:

- A. CONTRACTOR shall comply with 18 U.S.C. § 874, 40 U.S.C. § 3145, and the requirements of 29 C.F.R. pt. 3 as may be applicable, which are incorporated by reference into this Contract.
- B. CONTRACTOR or subcontractor shall insert in any subcontracts the clause above and such other clauses federal agencies may by appropriate instructions require, and also a

clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all of these Contract clauses.

- C. Breach. A breach of the contract clauses above may be grounds for termination of the contract, and for debarment as a contractor and subcontractor as provided in 29 C.F.R. § 5.12.

4. EQUAL EMPLOYMENT OPPORTUNITY

During the performance of this Contract, CONTRACTOR will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. If the CONTRACTOR does over \$10,000 in business a year that is funded, paid or reimbursed with federal funds, CONTRACTOR will take specific and affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. Such action shall include, but not be limited to the following:

- A. Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. CONTRACTOR agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
- B. CONTRACTOR will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.
- C. CONTRACTOR will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the Contractor's legal duty to furnish information.
- D. CONTRACTOR will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
- E. CONTRACTOR will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.
- F. In the event of CONTRACTOR's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this Contract may be canceled, terminated, or suspended in whole or in part and the CONTRACTOR may be declared ineligible for further federally funded contracts in accordance with procedures

authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

- G. CONTRACTOR will include the portion of the sentence immediately preceding paragraph (A) and the provisions of paragraphs (A) through (G) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. CONTRACTOR will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance:

Provided, however, that in the event CONTRACTOR becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency, the CONTRACTOR may request the United States to enter into such litigation to protect the interests of the United States.

5. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

- A. Overtime requirements. Neither CONTRACTOR or subcontractor contracting for any part of the Contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.
- B. Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (3)(A) of this section the CONTRACTOR and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such CONTRACTOR and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (3)(A) of this section, in the sum of \$27 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (3)(A) of this section.
- C. Withholding for unpaid wages and liquidated damages. The CITY shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the CONTRACTOR or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to

the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such CONTRACTOR or sub-contractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (3)(B) of this section.

- D. Subcontracts. The Contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (3)(A) through (D) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime CONTRACTOR shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (3)(A) through (D) of this section.

6. CLEAN AIR ACT

- A. CONTRACTOR agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. § 7401 et seq.
- B. CONTRACTOR agrees to report each violation to the CITY and understands and agrees that the CITY will, in turn, report each violation as required to assure notification to the Federal Emergency Management Agency, and the appropriate Environmental Protection Agency Regional Office.

CONTRACTOR agrees to include these requirements in each subcontract exceeding \$150,000 financed in whole or in part with federal funds.

7. FEDERAL WATER POLLUTION CONTROL ACT

- A. CONTRACTOR agrees to comply with all applicable standards, orders, or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1251 et seq.
- B. CONTRACTOR agrees to report each violation to the CITY and understands and agrees that the CITY will, in turn, report each violation as required to assure notification to the appropriate federal agency.
- C. CONTRACTOR agrees to include these requirements in each subcontract exceeding \$150,000 financed in whole or in part with federal funding.

8. DEBARMENT AND SUSPENSION

- A. This Contract is a Covered Transaction for purposes of 2 C.F.R. pt. 180 and 2 C.F.R. pt. 3000. As such, the CONTRACTOR is required to verify that none of the contractor's principals (defined at 2 C.F.R. § 180.995) or its affiliates (defined at 2 C.F.R. § 180.905) are excluded (defined at 2 C.F.R. § 180.940) or disqualified (defined at 2 C.F.R. § 180.935).
- B. CONTRACTOR must comply with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C, and must include a requirement to comply with these regulations in any lower tier Covered Transaction it enters into.
- C. This certification is a material representation of fact relied upon by the CITY. If it is later determined that the CONTRACTOR did not comply with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C, in addition to remedies available to CITY, the Federal

Government may pursue available remedies, including but not limited to suspension and/or debarment.

- D. CONTRACTOR agrees to comply with the requirements of 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C throughout the period of this Contract and to include a provision requiring such compliance in its lower tier covered transactions.

9. **CONTRACTOR** shall be required to comply with 2 CFR part 25, and obtain a unique entity identifier and/or be registered in the federal System for Award Management as appropriate.

10. BYRD ANTI-LOBBYING AMENDMENT

- A. Contractors who apply or bid for an award of \$100,000 or more shall file the required certification with CITY. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, officer or employee of Congress, or an employee of a Member of Congress in connection with obtaining any Federal contract, grant, or any other award covered by 31 U.S.C. § 1352. Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient who in turn will forward the certification(s) to the CITY.
- B. If applicable, CONTRACTOR's certification required by Appendix A to 44 CFR Part 18 contained at Addendum A-1 to this Contract is incorporated into this Contract.

11. PROCUREMENT OF RECOVERED MATERIALS

- A. In the performance of this Contract, CONTRACTOR shall make maximum use of products containing recovered materials that are EPA-designated items unless the product cannot be acquired:
- i. Competitively within a timeframe providing for compliance with the contract performance schedule;
 - ii. Meeting contract performance requirements; or
 - iii. At a reasonable price.
- B. Information about this requirement, along with the list of EPA- designated items, is available at EPA's Comprehensive Procurement Guidelines web site, <https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program>.
- C. CONTRACTOR also agrees to comply with all other applicable requirements of Section 6002 of the Solid Waste Disposal Act.

ADDENDUM A-1

APPENDIX A to 44 C.F.R. PART 18 – CERTIFICATION REGARDING LOBBYING Certification for Contracts, Grants, Loans, and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
3. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

Supplier, by Contract signature, certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of 31 U.S.C. Chap.38, Administrative Remedies for False Claims and Statements, apply to this certification and disclosure, if any.

ADDENDUM B—Sub-recipient information and requirements

Pursuant to 2 CFR 200.332(a)(1) Federal Award Identification

(i) Agency Name (must match the name associated with its unique entity identifier)		(ii) Unique Entity Identifier (i.e., DUNS)	City of Tacoma Number for This Agreement
(iii) Federal Award Identification Number (FAIN)	(iv) Federal Award Date	(v) Federal Period of Performance Start and End Date	(vi) Federal Budget Period Start and End Date
(vii) Amount of Federal Funds <i>Obligated</i> to the agency by this action: \$	(viii) Total Amount of Federal Funds <i>Obligated</i> to the agency	(ix) Total Amount of the Federal Award <i>Committed</i> to the agency \$	
(x) Federal Award Project Description:			
(xi) Federal Awarding Agency:	Pass-Through Entity: City of Tacoma	Awarding Official Name and Contact Information:	
(xii) Assistance Listing Number and Name (the pass-through entity must identify the dollar amount made available under each Federal award and the Assistance Listing number at time of disbursement)			(xiii) Identification of Whether the Award is R&D
(xiv) Indirect Cost Rate for the Federal Award	Award Payment Method (lump sum payment or reimbursement)		

ADDENDUM C
Appendices A and E of the USDOT Title VI Assurances

APPENDIX A

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

1. **Compliance with Regulations:** The Contractor (hereinafter includes consultants) will comply with the Acts and the Regulations relative to Non-discrimination in Federally-assisted programs of the U.S. Department of Transportation, (***Title of Modal Operating Administration***), as they may be amended from time to time, 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, will not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The Contractor will not participate directly or indirectly in the discrimination prohibited by the Acts and the Regulations, including employment practices when the contract covers any activity, project, or program set forth in Appendix B of 49 CFR Part 21.
3. **Solicitations for Subcontracts, Including Procurements of Materials and Equipment:** In all solicitations, either by competitive bidding, or negotiation made by the Contractor for work to be performed under a subcontract, including procurements of materials, or leases of equipment, each potential subcontractor or supplier will be notified by the Contractor of the Contractor's obligations under this contract and the Acts and the Regulations relative to Non-discrimination on the grounds of race, color, or national origin.
4. **Information and Reports:** The Contractor will provide all information and reports required by the Acts, the Regulations, and directives issued pursuant thereto and will permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Recipient or the (***Title of Modal Operating Administration***) to be pertinent to ascertain compliance with such Acts, Regulations, and instructions. Where any information required of a Contractor is in the exclusive possession of another who fails or refuses to furnish the information, the Contractor will so certify to the Recipient or the (***Title of Modal Operating Administration***), as appropriate, and will set forth what efforts it has made to obtain the information.
5. **Sanctions for Noncompliance:** In the event of a Contractor's noncompliance with the Non-discrimination provisions of this contract, the Recipient will impose such contract sanctions as it or the (***Title of Modal Operating Administration***) may determine to be appropriate, including, but not limited to:
 - a. withholding payments to the Contractor under the Contract until the Contractor complies; and/or
 - b. cancelling, terminating, or suspending a contract, in whole or in part.
6. **Incorporation of Provisions:** The Contractor will include the provisions of paragraphs one through six in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations and directives issued pursuant thereto. The Contractor will take action with respect to any subcontract or procurement as the Recipient or the (***Title of Modal Operating Administration***) may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the Contractor becomes involved in, or is threatened with litigation by a Contractor, or supplier because of such direction, the Contractor may request the Recipient to enter into any litigation to protect the interests of the Recipient. In addition, the Contractor may request the United States to enter into the litigation to protect the interests of the United States.

APPENDIX E

During the performance of this Contract, the Contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the "Contractor ") agrees to comply with the following non-discrimination statutes and authorities; including but not limited to:

Pertinent Non-Discrimination Authorities:

- Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d et seq., 78 stat. 252), (prohibits discrimination on the basis of race, color, national origin); and 49 CFR Part 21.
- The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 U.S.C. § 4601), (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);
- Federal-Aid Highway Act of 1973, (23 U.S.C. § 324 et seq.), (prohibits discrimination on the basis of sex);
- Section 504 of the Rehabilitation Act of 1973, (29 U.S.C. § 794 et seq.), as amended, (prohibits discrimination on the basis of disability); and 49 CFR Part 27;
- The Age Discrimination Act of 1975, as amended, (42 U.S.C. § 6101 et seq.), (prohibits discrimination on the basis of age);
- Airport and Airway Improvement Act of 1982, (49 USC § 471, Section 47123), as amended, (prohibits discrimination based on race, creed, color, national origin, or sex);
- The Civil Rights Restoration Act of 1987, (PL 100-209), (Broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, The Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms "programs or activities" to include all of the programs or activities of the Federal-aid recipients, sub-recipients and Contractor s, whether such programs or activities are Federally funded or not);
- Titles II and III of the Americans with Disabilities Act, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 U.S.C. §§ 12131-12189) as implemented by Department of Transportation regulations at 49 C.F.R. parts 37 and 38;
- The Federal Aviation Administration's Non-discrimination statute (49 U.S.C. § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures Non-discrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations;
- Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of Limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);
- Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 U.S.C. 1681 et seq).



PAYMENT BOND TO THE CITY OF TACOMA

Resolution No. [Enter Reso # Here]
Bond No.

That we, the undersigned, [Supplier name]
as principal, and _____
as a surety, are jointly and severally held and firmly bound to the CITY OF TACOMA, in the penal sum of,
[\$(dollar value), plus any applicable taxes], for the payment whereof Contractor and Surety bind themselves,
their executors, administrators, legal representatives, successors and assigns, jointly and severally, firmly by these presents.

This obligation is entered into in pursuance of the statutes of the State of Washington, the Ordinances of the City of Tacoma.

WHEREAS, under and pursuant to the City Charter and general ordinances of the City of Tacoma, the said City has or is about to enter with the above bounden principal, a contract, providing for

Specification No. [Enter Spec # Here]

Specification Title: [Enter Spec Title Here]

Contract No. [Enter Contract # Here]

(which contract is referenced to herein and is made a part hereof as though attached hereto), and

WHEREAS, the said principal has accepted, the said contract, and undertake to perform the work therein provided for in the manner and within the time set forth.

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 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.

No suit or action shall be commenced hereunder by any claimant unless claimant shall have given the written notices to the City, and where required, the Contractor, in accordance with RCW 39.08.030.

The amount of this bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by Surety of claims which may be properly filed in accordance with RCW 39.08 whether or not suit is commenced under and against this bond.

If any claimant shall commence suit and obtain judgment against the Surety for recovery hereunder, then the Surety, in addition to such judgment and attorney fees as provided by RCW 39.08.030, shall also pay such costs and attorney fees as may be incurred by the City as a result of such suit. Venue for any action arising out of or in connection with this bond shall be in Pierce County, WA.

Surety companies executing bonds must be authorized to transact 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. Department of the Treasury.

Resolution No. [Enter Reso # Here]
Specification No. [Enter Spec # Here]
Contract No. [Enter Contract # Here]

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

Principal: [Supplier name]

By: _____

Surety:

By: _____

Agent's Name: _____

Agent's Address: _____



PERFORMANCE BOND TO THE CITY OF TACOMA

Resolution No. [Enter Reso # Here]
Bond No.

That we, the undersigned, [Supplier Name]
as principal, and _____
as a surety, are jointly and severally held and firmly bound to the CITY OF TACOMA, in the penal sum of
[\$[dollar value], plus any applicable tax], for the payment whereof Contractor and Surety bind themselves,
their executors, administrators, legal representatives, successors and assigns, jointly and severally, firmly by these presents.

This obligation is entered into in pursuance of the statutes of the State of Washington, the Ordinances of the City of Tacoma.

WHEREAS, under and pursuant to the City Charter and general ordinances of the City of Tacoma, the said City has or is about to enter with the above bounden principal, a contract, providing for

Specification No. [Enter Spec # Here]

Specification Title: [Enter Spec Title Here]

Contract No. [Enter Contract # Here]

(which contract is referenced to herein and is made a part hereof as though attached hereto), and

WHEREAS, the said principal has accepted, the said contract, and undertake to perform the work therein provided for in the manner and within the time set forth.

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 increase.

If the City shall commence suit and obtain judgment against the Surety for recovery hereunder, then the Surety, in addition to such judgement, shall pay all costs and attorney's fees incurred by the City in enforcement of its rights hereunder. Venue for any action arising out of in in connection with this bond shall be in Pierce County, Washington.

Surety companies executing bonds must be authorized to transact 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. Department of the Treasury.

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

Principal: [Supplier name]

By: _____

Surety:

By: _____

Agent's Name: _____

Agent's Address: _____

PART II

TECHNICAL SPECIFICATIONS

TACOMA WATER
RAVENSDALE, WASHINGTON

BIDDING REQUIREMENTS
AND
CONTRACT DOCUMENTS

for the construction of the
GREEN RIVER FILTRATION FACILITY
OZONE SYSTEM REPLACEMENT PROJECT

JACOBS

Bellevue, Washington

December 2025

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SECTION 00 01 07
SEALS PAGE

See Table of Contents for author of each specification section, identified by author's initials as follows:

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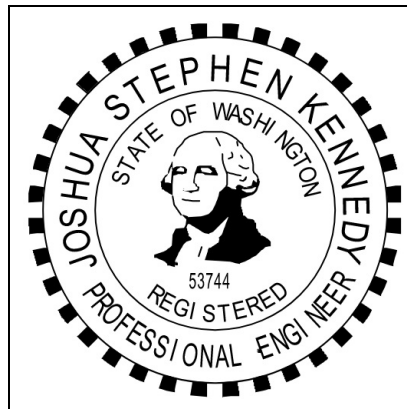
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DALLAS ANDERSON = DJA

GARY ERB = GTE

SPECIFICATIONS



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March 19, 2026

Joshua Stephen Kennedy

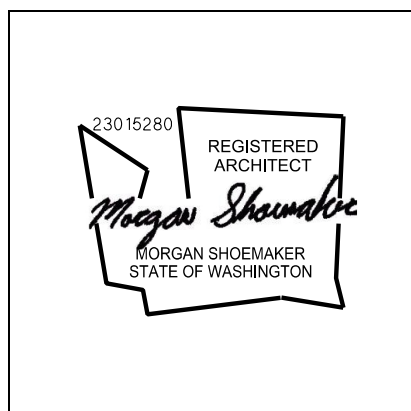
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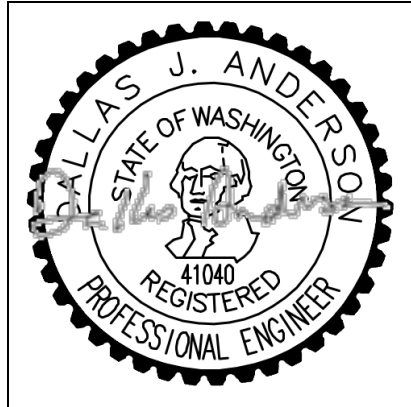
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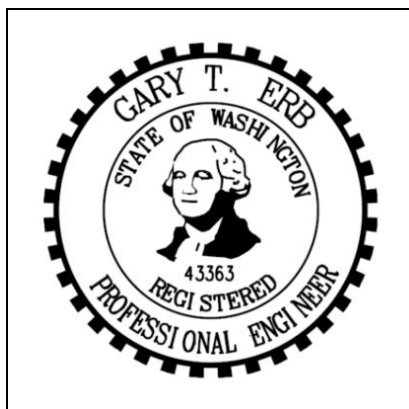
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March 19, 2026

Dallas J. Anderson



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March 19, 2026

Gary T. Erb

END OF SECTION

TABLE OF CONTENTS

<u>Section</u>	<u>Person Responsible</u>	<u>Title</u>	<u>Pages</u>
PART 1— <u>SPECIFICATIONS</u>			
DIVISION 01—GENERAL REQUIREMENTS			
01 11 00	JSK	Summary of Work.....	1- 2
01 26 00	JSK	Contract Modification Procedures	1- 4
01 29 00	JSK	Payment Procedures.....	1- 3
01 31 13	JSK	Project Coordination	1- 8
01 31 19	JSK	Project Meetings	1- 4
01 32 00	JSK	Construction Progress Documentation	1- 7
01 33 00	JSK	Submittal Procedures	1- 9
		Supplement:	
	JSK	Transmittal of Contractor's Submittal	1- 1
01 43 33		Manufacturers' Field Services	1- 4
		Supplement:	
	JSK	Manufacturer's Certificate of Proper Installation	1- 1
01 45 16.13	JSK	Contractor Quality Control	1- 9
01 45 33	JSK	Special Inspection, Observation, and Testing.....	1- 5
		Supplements:	
	JSK	Contractor's Statement of Responsibility	1- 2
	JSK	Fabricator's Certificate of Compliance.....	1- 1
	JSK	Statement of Special Inspections	1- 2
	JSK	Special Inspection Observation and Testing 2021 IBC Tables	1- 4
01 61 00	JSK	Common Product Requirements	1- 8
		Supplement:	
	JSK	Manufacturer's Certificate of Compliance	1- 1
01 64 00	JSK	Owner-Furnished Products	1- 7
01 77 00	JSK	Closeout Procedures.....	1- 4
01 78 23	JSK	Operation and Maintenance Data.....	1- 6
		Supplement:	
	JSK	Maintenance Summary Form.....	1- 2
01 88 15	JC	Anchorage and Bracing.....	1- 7
01 91 14	JSK	Equipment Testing and Facility Startup	1- 7
		Supplements:	
	JSK	Unit Process Startup Form	1- 1
	JSK	Facility Performance Demonstration/Certification Form	1- 1

GRFF OZONE SYSTEM REPLACEMENT

Pages

DIVISION 02—EXISTING CONDITIONS

02 41 00	JSK	Demolition	1- 8

DIVISION 03—CONCRETE

03 30 10	JC	Cast-In-Place Concrete	1- 15

DIVISION 04—NOT USED

DIVISION 05—METALS

05 05 19	JC	Anchor Bolts	1- 10

DIVISION 06 AND DIVISION 07—NOT USED

DIVISION 08—OPENINGS

08 33 33	MS	Overhead Coiling Doors	1- 5

DIVISION 09—FINISHES

09 29 01	MS	Gypsum Board	1- 3
09 90 00	MS	Painting and Coating.....	1- 21
		Supplements:	
	MS	Paint System Data Sheet (PSDS).....	1- 1
	MS	Paint Product Data Sheet (PPDS)	1- 1

DIVISION 10 THROUGH 25—NOT USED

DIVISION 26—ELECTRICAL

26 05 02	DJA	Basic Electrical Requirements	1- 6
26 05 04	DJA	Basic Electrical Materials and Methods	1- 9
26 05 05	DJA	Conductors	1- 18
26 05 26	DJA	Grounding and Bonding for Electrical Systems	1- 4
26 05 33	DJA	Raceway and Boxes	1- 14
26 05 70	DJA	Electrical Systems Analysis.....	1- 9
26 08 00	DJA	Commissioning of Electrical Systems	1- 15
26 09 13	DJA	Power Measurement and Control.....	1- 4
26 24 19	DJA	Low-Voltage Motor Control Centers.....	1- 14
26 29 23	DJA	Variable-Frequency Motor Controllers.....	1- 14
26 33 53	DJA	Static Uninterruptible Power Supply	1- 10

DIVISION 27 THROUGH DIVISION 39—NOT USED

DIVISION 40—PROCESS INTERCONNECTIONS

40 05 15	JSK	Piping Support Systems	1-	9
		Supplement:		
	JSK	Table 1: Area Classification.....	1-	1
40 27 00	JSK	Process Piping—General and Specialties	1-	17
40 27 00.03	JSK	Carbon Steel Pipe and Fittings—		
		General Service Data Sheet	1-	5
40 27 00.08	JSK	Stainless Steel Pipe and Fittings—		
		General Service Data Sheet	1-	2
40 27 00.10	JSK	Polyvinyl Chloride (PVC) Pipe and Fittings Data Sheet.....	1-	2
40 27 02	JSK	Process Valves and Process Specialties.....	1-	14
		Supplements:		
	JSK	Electric Valve and Actuator Schedule	1-	4
	JSK	Manual Valve Schedule	1-	4
	JSK	Self-Regulated Valve Schedule	1-	1
40 42 13	JSK	Process Piping Insulation.....	1-	6
		Supplement:		
	JSK	Service and Insulation Thickness Table	1-	1
40 80 01	JSK	Process Piping Leakage Testing	1-	3
40 90 00	GTE	Instrumentation and Control for Process Systems.....	1-	49
		Supplements:		
	GTE	PLC I/O Schedule	1-	6
	GTE	Control Panel Schedule.....	1-	1
	GTE	Preparation for Testing and Functional Test Forms	1-	4
40 91 00	GTE	Instrumentation and Control Components.....	1-	37
		Supplement:		
	GTE	Instruments List	1-	30

DIVISION 41 THROUGH DIVISION 43—NOT USED

DIVISION 44—POLLUTION AND WASTE CONTROL EQUIPMENT

44 42 56.02	JSK	Horizontal End-Suction Centrifugal Pumps	1-	9
		Supplement:		
	JSK	Ozone Injection Pump Data Sheet	1-	2
	JSK	Open Loop Cooling Water Pump Data Sheet	1-	2
	JSK	Closed Loop Coolant Water Pump Data Sheet.....	1-	2
44 42 56.17	JSK	Sampling Pumps	1-	3
		Supplement:		
	JSK	Sampling Pump Data Sheet	1-	2

GRFF OZONE SYSTEM REPLACEMENT

			<u>Pages</u>
44 44 13.01	JSK	Chemical Metering Pumps.....	1- 5
		Supplement:	
	JSK	Sodium Bisulfite Feed Pumps 1 - 4 Data Sheet.....	1- 2
44 44 56.03	JSK	Nitrogen Boost Skid.....	1- 5

DIVISION 45 THROUGH DIVISION 49—NOT USED

PART 2—DRAWINGS (BOUND SEPARATELY)

PART 3—VEOLIA POWER SUPPLY UNIT PROCUREMENT PROPOSAL AND
CONTROL PANEL PROCUREMENT PROPOSAL

END OF SECTION

PART 1

SPECIFICATIONS

**SECTION 01 11 00
SUMMARY OF WORK**

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

- A. The completed Work will provide Owner with replacement of select ozone generation system equipment at the Tacoma Water Green River Filtration Facility. The Project includes procurement and installation of new electrical valve actuators, instrumentation, MCC buckets, and centrifugal pumps for cooling and ozone injection. It also includes installation of ozone destruct skid equipment, Ozone Power Supply Units (PSU), and replacement of control panel back panels which are Owner furnished products. The Work also includes integration and programming of the new master ozone control panel (MOCP) by the Ozone system supplier (OSS) and integration of the MOCP into the plant SCADA system by the Process and Instrumentation Control System (PICS) Integrator.
- B. Contractor is responsible for restoring any spaces used for staging areas to pre-existing conditions upon project completion.
- C. Contractor shall perform controls integration work by the chosen Process and Instrumentation Control (PIC) Integrator under the General Contract.
 - 1. PIC Integrator:
S&B, Inc.
13200 S.E. 30th Street, Suite A.
Bellevue, WA 98005.
Telephone: (425) 644-1700.
Email: jstead@sb-inc.com

1.02 OWNER-FURNISHED PRODUCTS

- A. The Owner has a separate Contract with the OSS for procurement of major equipment and services related to start-up of the ozone equipment. The Owner has prepurchased the major ozone equipment from the OSS for installation by the Contractor.
- B. Refer to Section 01 64 00, Owner-Furnished Products, and Section 01 31 13, Project Coordination.

GRFF OZONE SYSTEM REPLACEMENT

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES**

PART 1 GENERAL

1.01 PROPOSAL REQUESTS

- A. Owner may, in anticipation of ordering an addition, deletion, or revision to the Work, request Contractor to prepare a detailed proposal of cost and times to perform contemplated change.
- B. Proposal request will include reference number for tracking purposes and detailed description of and reason for proposed change, and such additional information as appropriate and as may be required for Contractor to accurately estimate cost and time impact on Project.
- C. Proposal request is for information only; Contractor is neither authorized to execute proposed change nor to stop Work in progress as result of such request.
- D. Contractor's written proposal shall be transmitted to Engineer promptly, but not later than 14 days after Contractor's receipt of Owner's written request. Proposal shall remain firm for a maximum period of 45 days after receipt by Engineer.
- E. Owner's request for proposal or Contractor's failure to submit such proposal within the required time period will not justify a Claim for an adjustment in Contract Price or Contract Times (or Milestones).

1.02 CLAIMS

- A. Include, at a minimum:
 - 1. Specific references including (i) Drawing numbers, (ii) Specification section and article or paragraph number, and (iii) Submittal type, Submittal number, date reviewed, Engineer's comment, as applicable, with appropriate attachments.
 - 2. Stipulated facts and pertinent documents, including photographs and statements.
 - 3. Interpretations relied upon.
 - 4. Description of (i) nature and extent of Claim, (ii) who or what caused the situation, (iii) impact to the Work and work of others, and (iv) discussion of claimant's justification for requesting a change to price or times or both.

GRFF OZONE SYSTEM REPLACEMENT

5. Estimated adjustment in price claimant believes it is entitled to with full documentation and justification.
6. Requested Change in Contract Times: Include at least (i) Progress Schedule documentation showing logic diagram for request, (ii) documentation that float times available for Work have been used, and (iii) revised activity logic with durations including sub-network logic revisions, duration changes, and other interrelated schedule impacts, as appropriate.
7. Documentation as may be necessary as set forth below for Work Change Directive, and as Engineer may otherwise require.

1.03 WORK CHANGE DIRECTIVES

A. Procedures:

1. Engineer will:
 - a. Initiate, including a description of the Work involved and any attachments.
 - b. Affix signature, demonstrating Engineer's recommendation.
 - c. Transmit electronic copy to Owner for authorization.
2. Owner will:
 - a. Affix signature, demonstrating approval of the changes involved.
 - b. Return signed electronic copy to Engineer, who will send it to the Resident Project Representative or other field representative, and Contractor.
3. Upon completion of Work covered by the Work Change Directive or when final Contract Times and Contract Price are determined, Contractor shall submit documentation for inclusion in a Change Order.
4. Contractor's documentation shall include but not be limited to:
 - a. Appropriately detailed records of Work performed to enable determination of value of the Work.
 - b. Full information required to substantiate resulting change in Contract Times and Contract Price for Work. On request of Engineer, provide additional data necessary to support documentation.
 - c. Support data for Work performed on a unit price or Cost of the Work basis with additional information such as:
 - 1) Dates Work was performed, and by whom.
 - 2) Time records, wage rates paid, and equipment rental rates.
 - 3) Invoices and receipts for materials, equipment, and subcontracts, all similarly documented.

- B. Effective Date of Work Change Directive: Date of signature by Owner, unless otherwise indicated thereon.

1.04 CHANGE ORDERS

A. Procedure:

1. Engineer will prepare electronic copy of proposed Change Order and transmit such with Engineer's written recommendation and request to Contractor for signature.
2. Contractor shall, upon receipt, either: (i) promptly sign, retaining one for its file, and return signed electronic copy to Engineer for Owner's signature, or (ii) return unsigned with written justification for not executing Change Order.
3. Engineer will, upon receipt of Contractor signed copy, promptly forward Engineer's written recommendation and partially executed copy for Owner's signature, or if Contractor fails to execute the Change Order, Engineer will promptly so notify Owner and transmit Contractor's justification to Owner.
4. Upon receipt of Contractor-executed Change Order, Owner will promptly either:
 - a. Execute Change Order.
 - b. Return to Engineer unsigned with written justification for not executing Change Order.
5. Upon receipt of Owner-executed Change Order, Engineer will transmit to Contractor, Resident Project Representative or other field representative, and retain one copy, or if Owner fails to execute the Change Order, Engineer will promptly so notify Contractor and transmit Owner's justification to Contractor.
6. Upon receipt of Owner-executed Change Order, Contractor shall:
 - a. Perform Work covered by Change Order.
 - b. Revise Schedule of Values to adjust Contract Price and submit with next Application for Payment.
 - c. Revise Progress Schedule to reflect changes in Contract Times, if any, and to adjust times for other items of Work affected by change.
 - d. Enter changes in Project record documents after completion of change related Work.

B. In signing a Change Order, Owner and Contractor acknowledge and agree that:

1. Stipulated compensation (Contract Price or Contract Times, or both) set forth includes payment for (i) the Cost of the Work covered by the Change Order, (ii) Contractor's fee for overhead and profit, (iii) interruption of Progress Schedule, (iv) delay and impact, including cumulative impact, on other Work under the Contract Documents, and (v) extended overheads.

GRFF OZONE SYSTEM REPLACEMENT

2. Change Order constitutes full mutual accord and satisfaction for the change to the Work.
3. Unless otherwise stated in the Change Order, all requirements of the original Contract Documents apply to the Work covered by the Change Order.

1.05 COST OF THE WORK

- A. The supplemental costs allowed for rental equipment and machinery shall be per the General Conditions and Supplementary Conditions.

1.06 FIELD ORDER

- A. Engineer will issue Field Orders, with three copies to Contractor.
- B. Effective date of the Field Order shall be the date of signature by Engineer, unless otherwise indicated thereon.
- C. Contractor shall acknowledge receipt by signing and returning one copy to Engineer.
- D. Field Orders will be incorporated into subsequent Change Orders, as a no-cost change to the Contract.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 29 00
PAYMENT PROCEDURES**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Informational Submittals:
 - 1. Schedule of Values: Submit on Contractor's standard form.
 - 2. Application for Payment.
 - 3. Final Application for Payment.

1.02 SCHEDULE OF VALUES

- A. Upon request of Engineer, provide documentation to support the accuracy of the Schedule of Values.
- B. Unit Price Work: Reflect unit price quantity and price breakdown from conformed Bid Form.
- C. Lump Sum Work:
 - 1. Reflect specified cash and contingency allowances and alternates, as applicable.
 - 2. List bonds and insurance premiums, mobilization, demobilization, preliminary and detailed progress schedule preparation, equipment testing, facility startup, and contract closeout separately.
 - 3. Break down by Division 02 through Division 49.
- D. An unbalanced or front-end loaded schedule will not be acceptable.
- E. Summation of the complete Schedule of Values representing all the Work shall equal the Contract Price.

1.03 APPLICATION FOR PAYMENT

- A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment for each schedule and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of Contractor.
- B. Use detailed Application for Payment Form suitable to Owner.
- C. Provide separate form for each schedule as applicable.

GRFF OZONE SYSTEM REPLACEMENT

- D. Include accepted Schedule of Values for each schedule or portion of lump sum Work and the unit price breakdown for the Work to be paid on a unit priced basis.
- E. Include separate line item for each Change Order and Work Change Directive executed prior to date of submission. Provide further breakdown of such as requested by Engineer.
- F. Preparation:
 - 1. Round values to nearest dollar.
 - 2. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form(s) for each schedule as applicable, a listing of materials on hand for each schedule as applicable, and such supporting data as may be requested by Engineer.

1.04 MEASUREMENT—GENERAL

- A. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and specifications as specified in National Institute of Standards and Technology, Handbook 44.
- B. Whenever pay quantities of material are determined by weight, weigh material on scales furnished by Contractor and certified accurate by state agency responsible. Obtain weight or load slip from weigher and deliver to Owner's representative at point of delivery of material.

1.05 PAYMENT

- A. Payment for all Lump Sum Work shown or specified in Contract Documents is included in the Contract Price. Payment will be based on a percentage complete basis for each line item of the accepted Schedule of Values.
- B. Payment for Lump Sum Work covers all Work specified or shown within the limits or specification sections as follows:
 - 1. All Work shown on the Drawings and in specification sections.

1.06 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

- A. Payment will not be made for following:
 - 1. Loading, hauling, and disposing of rejected material.
 - 2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.

3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.
4. Material not unloaded from transporting vehicle.
5. Defective Work not accepted by Owner.
6. Material remaining on hand after completion of Work.

1.07 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

- A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings and preliminary operation and maintenance data is acceptable to Engineer.
- B. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 13
PROJECT COORDINATION

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational:

1. Ozone outage window work sequencing plan and schedule.
2. Process or facility shutdown plan.

1.02 FACILITY SUBSTANTIAL COMPLETION

A. Substantial completion is defined as the time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work is sufficiently complete, in accordance with the Contract Documents, so that the Work can be utilized for the purposes for which it is intended.

B. Ozone facility and all facility sub-components required for operation of the ozone system shall be substantially complete by the dates provided in the Contract. The components required for substantial completion shall include, but not be limited to, the following:

- a. Installation, testing, and commissioning of the ozone equipment, including power supply units, programmable logic controller (PLC) backpanels, ozone destruct units, instrumentation, actuators, automatic strainers, pumps, and ancillary equipment required for operation of the ozone system. Ozone equipment shall be tested in Manual at the individual control panels and tested in Automatic from the Master Ozone Control Panel and the Operator Control Center (SCADA) terminals for all Operating Control Modes.
- b. Headworks PLC panel.
- c. Sample Stations 1-5 control panel and process mechanical upgrades.
- d. Replacement of existing process instrumentation.
- e. Sodium bisulfite dosing pump upgrades.
- f. Ozone MCC upgrades.
- g. Ozone Generation Facility uninterruptible power supply (UPS) replacement/upgrade.

GRFF OZONE SYSTEM REPLACEMENT

C. Certificate of Substantial Completion and Final Inspection:

1. When Contractor considers the entire Work ready for its intended use, Contractor shall notify Owner and Engineering in writing that the entire Work is substantially complete and request that the Engineer issue a certification of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
2. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall conduct an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a certificate of Substantial Completion which shall fix the date of Substantial Completion.
3. At the time of receipt of the certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.
4. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly conduct a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

1.03 RELATED WORK AT SITE

A. General:

1. Other work that is either directly or indirectly related to scheduled performance of the Work under these Contract Documents, listed henceforth, is anticipated to be performed at Site by others.
2. Coordinate the Work of these Contract Documents with work of others as specified in General Conditions.
3. Include sequencing constraints specified herein as a part of Progress Schedule.

1.04 OWNER-FURNISHED PRODUCTS

- A. The Owner has two Contracts with the Ozone System Supplier (OSS) for this Project:
 - 1. The Power Supply Unit (PSU), denoted with (◇) on the Drawings, will be supplied by the OSS and installed by the Contractor.
 - 2. The OSS shall also supply replacement PLC backpanels and select equipment and instruments, denoted with (◆) on the Drawings, and installed by the Contractor. The OSS is also responsible for startup and testing of this equipment, programming of the ozone system equipment, and startup services to integrate the OSS control system.
- B. Contractor is responsible for coordinating with the Owner and OSS for scheduling, delivery, and execution of the work which depends on these Owner Contracts.
- C. Refer to Section 01 64 00, Owner-Furnished Products, for additional information.

1.05 PROJECT MILESTONES AND SCHEDULING

- A. General: Include the Milestones specified herein as a part of the Progress Schedule required under Section 01 32 00, Construction Progress Documentation.
- B. Project Milestones:
 - 1. Generally described in the Agreement Form. Owner reserves the right to change the allowable Ozone Outage Window, if needed, and will provide the Contractor notice as early as is feasible. Delivery date of OSS supplied equipment is approximate and is subject to change. Following is a detailed description of each:
 - a. Delivery of Contractor supplied equipment.
 - b. Delivery of OSS supplied power supply units, control panels, and instrumentation by November 1, 2026.
 - c. Beginning of Ozone Outage Window: January 4, 2027.
 - d. End of Ozone Outage Window: March 1, 2027.
 - e. Return to service of minimum one ozone generator and associated sub-systems as required for functional operation of ozone injection into one reactor pipeline, including automated operation from OMCP: March 1, 2027.
 - f. Project Substantial Completion: June 15, 2027.

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C. Scheduling of Work:

1. It is the intent of the Owner to award this contract and begin work as soon as possible.
2. Where the contract documents mention notification periods in hours or days, these time periods are assumed to be working days unless specifically stated otherwise. For example, a requirement of 48-hours notification for work desired to be performed at 1:00 p.m. Monday requires notification be provided no later than 1:00 p.m. the preceding Thursday.
3. All work shall be performed Monday through Friday during normal working hours from 7:00 a.m. to 5:00 p.m. No work shall be performed on site on Saturday, Sunday, or holidays as defined by the General Provisions without the written authorization of the Owner or Engineer. Permission to work on Saturdays, Sundays, holidays, before or after the normal working hours may be subject to additional conditions, including, but not limited to, staffing availability and reimbursement of Owner costs.

1.06 FACILITY OPERATIONS AND WORK SEQUENCING/CONSTRAINTS

- A. Continuous operation of Owner's facilities is of critical importance. Except for short shutdowns (as described in Paragraph G), ozonation must continue at all times outside the Ozone Outage Window. At least one ozone generator and associated sub-systems must remain in operation at all times.
- B. Equipment that is considered redundant or non-essential to operation of the ozone system may be demolished or salvaged and replaced during normal operation if approved by Owner and Engineer, including:
 1. Power supply unit and cooling water system for one ozone generator.
 2. Demolition of the 4-inch ozone injection skids.
 3. Injection pumps associated with one pipeline reactor.
 4. One ozone destruct skid.
 5. Work associated with the nitrogen boost system.
 6. Work associated with Sample Stations 1-4. Note that a minimum of two sample stations shall remain online at all times.
 7. Work associated with Sample Station 5. Outage of this station shall be coordinated with Owner and shall be completed in under 48 hours.
 8. Work associated with the New Headworks Building Panel.
 9. Work associated with Network Communications Panels.
 10. Work associated with sodium bisulfite dosing pumps.
 11. Loose actuators and instruments may be demolished or salvaged, as indicated on Drawings, and replaced where redundancy is present.

C. Example Preliminary Construction Sequence of Key Activities:

1. Planning of Work and procurement of materials and equipment.
2. Demolition of redundant ozone equipment or non-essential equipment, as defined in herein, and replacement with new equipment, in preparation for the ozone outage window.
3. Work during ozone outage window:
 - a. Demolition and replacement of PLC backpanels and Operator Interface Units (OIU) for Ozone Master Control Panel, Ozone Injection Control Panel, Ozone Destructor 1 Panel, Ozone Destructor 2 Panel, and Ozone Generator Facility UPS.
 - b. Demolition and replacement of non-redundant loose actuators and instruments required for operation of ozone system.
 - c. Demolition and replacement of heat rejection water pumps.
 - d. Demolition and replacement of motor control center (MCC) buckets.
 - e. Any field welding or metal grinding that can cast sparks shall be completed with proper ventilation while ozone system is offline to avoid ignition in oxygen enriched environments; passivation of field welds and cleaning of stainless steel pipe for oxygen and ozone service, as described in Section 40 27 00, Process Piping—General and Specialties Article Flexible Pipe Connections to Equipment.
 - f. Electrical wiring, terminations, and testing.
 - g. Functional testing of Contractor supplied equipment, including power failure tests, to confirm proper operation.
 - h. Startup and commissioning of a minimum of one ozone generator, one pipeline reactor and associated ozone injection skid, and one ozone destruct skid in coordination with OSS, and Uninterruptable Power Supply (UPS) for Ozone System including operational readiness tests (ORT) and functional demonstration tests (FDT) on all associated equipment required for operation in local and remote operating modes.
4. Demolition and replacement of remaining ozone equipment.
5. Electrical wiring, terminations, and testing of remaining equipment.
6. Functional testing of Contractor supplied equipment to confirm proper operation.
7. Startup and commissioning of remaining ozone equipment in coordination with OSS, including ORT and FDT on remaining equipment required for substantial completion.
8. Performance testing by OSS on each ozone generator.

GRFF OZONE SYSTEM REPLACEMENT

D. Work During Ozone Outage Window:

1. Ozone Outage Window: Shutdown of ozone system for demolition, installation, and commissioning of ozone equipment is limited to 8 weeks. Work that must be performed during the planned shutdown includes demolition and installation of key equipment, instrumentation, and control panels associated with the Ozone System as detailed in Article C.3.
2. Testing and commissioning of the control panel by OSS is anticipated to be 2 weeks duration. Contractor shall coordinate with OSS to develop a detailed schedule a minimum of 8 weeks in advance for the 8-week outage period.
3. Contractor shall not commence demolition of non-redundant ozone equipment until schedule is approved and authorization has been received from Owner and Engineer.
4. Contractor shall plan and schedule the work as required to complete the identified work during the ozone outage window.
5. It is critical that Contractor complete the Work in a timely manner within the requirements of the Contract Times due to the need to operate the Green River Filtration Facility (GRFF) upon completion of the Project. Readiness of the new ozone equipment for operation by March 1, 2027 is of paramount importance. To minimize the overall duration to complete the Work and the impact to Owner's operation of GRFF, Contractor shall optimize the sequence of work and reflect that in the required Construction Progress Documentation.

E. Work During Normal Operation:

1. Normal operation is defined as all times outside of the ozone outage window.
2. Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of Owner's operations.
3. When necessary, plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items to maintain continuous operations of Owner's facility.
4. Owner shall be responsible for shutting down and isolating equipment prior to Contractor performing work. Contractor shall not close lines, open or close valves, or take other action which would affect the operation of existing systems, except as specifically required by the Contract Documents and after authorization by Owner and Engineer. Such authorization will be considered within 48 hours after receipt of Contractor's written request.
5. Process or Facility Shutdown: Disruption to power, communications, or equipment operation will be considered upon 48 hours written request to

Owner and Engineer. Describe the reason, anticipated length of time, and areas affected by the outage. Provide temporary provisions for continuous power supply to critical facility components. Shutdowns of the ozone system longer than 48 hours will not be permitted outside of the ozone outage window.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CUTTING, FITTING, AND PATCHING

- A. Cut, fit, adjust, or patch Work and work of others, including excavation and backfill as required, to make Work complete.
- B. Obtain prior written authorization of Engineer or Owner before commencing Work to cut or otherwise alter:
 - 1. Structural or reinforcing steel, structural column or beam, elevated slab, trusses, or other structural member.
 - 2. Weather-resistant or moisture-resistant elements.
 - 3. Efficiency, maintenance, or safety of element.
 - 4. Work of others.
- C. Refinish surfaces to provide an even finish.
 - 1. Refinish continuous surfaces to nearest intersection.
 - 2. Refinish entire assemblies.
 - 3. Finish restored surfaces to such planes, shapes, and textures that no transition between existing work and the Work is evident in finished surfaces.
 - 4. Restore painted surfaces and color match with existing paint color, seek approval from Owner on color prior to painting.
- D. Restore existing work, underground facilities, and surfaces that are to remain in completed Work including concrete-embedded piping, conduit, and other utilities as specified and as shown on the Drawings.
- E. Make restorations with new materials and appropriate methods as specified for new Work of similar nature; if not specified, use recommended practice of manufacturer or appropriate trade association.
- F. Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces and fill voids.

GRFF OZONE SYSTEM REPLACEMENT

- G. Remove specimens of installed Work for testing when requested by Engineer.

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

PART 1 GENERAL

1.01 GENERAL

- A. Engineer or Owner will schedule virtual and/or physical arrangements for meetings throughout progress of the Work, prepare meeting agenda with regular participant input and distribute with written notice of each meeting, preside at meetings, record minutes to include significant proceedings and decisions, and reproduce and distribute copies of minutes within 5 days after each meeting to participants and parties affected by meeting decisions.

1.02 PRECONSTRUCTION CONFERENCE

- A. Contractor shall be prepared to discuss the following subjects, as a minimum:
1. Required schedules.
 2. Status of Bonds and insurance.
 3. Sequencing of critical path work items.
 4. Updated Progress Schedule.
 5. Progress payment procedures.
 6. Project changes and clarification procedures.
 7. Use of Site, access, office and storage areas, security and temporary facilities.
 8. Major product delivery and priorities.
 9. Contractor's safety plan and representative.
- B. Attendees will include:
1. Owner's representatives.
 2. Contractor's office representative.
 3. Contractor's resident superintendent.
 4. Contractor's quality control representative.
 5. Process Instrumentation and Control Systems (PICS) Integrator.
 6. Subcontractors' representatives whom Contractor may desire or Engineer may request to attend.
 7. Engineer's representatives.
 8. Others as appropriate.

GRFF OZONE SYSTEM REPLACEMENT

1.03 PRELIMINARY SCHEDULES REVIEW MEETING

- A. As set forth in General Conditions and Section 01 32 00, Construction Progress Documentation.

1.04 PROGRESS MEETINGS

- A. Owner will schedule regular progress meetings at Site, conducted bi-weekly (every 2 weeks) prior to onsite field activities and weekly once onsite field activities commence. Meetings will be used to review the Work progress, Progress Schedule, Schedule of Submittals, Application for Payment, contract modifications, and other matters needing discussion and resolution.
- B. Attendees will include:
 - 1. Owner's representative(s), as appropriate.
 - 2. Contractor, Subcontractors, and Suppliers, as appropriate.
 - 3. Ozone System Supplier (OSS), as appropriate.
 - 4. Engineer's representative(s).
 - 5. Others as appropriate.

1.05 QUALITY CONTROL MEETINGS

- A. Scheduled by Engineer on regular basis and as necessary to review test and inspection reports, and other matters relating to quality control of the Work and work of other Contractors.
- B. Attendees will include:
 - 1. Contractor.
 - 2. Contractor's designated quality control representative.
 - 3. Subcontractors and Suppliers, as necessary.
 - 4. Owner's representatives.

1.06 PROCESS INSTRUMENTATION AND CONTROL SYSTEMS (PICS) COORDINATION MEETINGS

- A. Owner will schedule meetings at Site, conducted monthly to review specific requirements of PICS Integrator and PICS Installer work.

B. Attendees will include:

1. Contractor.
2. Owner.
3. PICS.
4. Engineer's representatives.
5. OSS (only included when necessary for coordination).

1.07 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene at Site prior to commencing the Work of that section.
- B. Require attendance of entities directly affecting, or affected by, the Work of that section.
- C. Notify Engineer 10 days in advance of meeting date.
- D. Provide suggested agenda to Engineer to include reviewing conditions of installation, preparation and installation or application procedures, and coordination with related Work and work of others.

1.08 FACILITY STARTUP MEETINGS

- A. Schedule and attend a minimum of three facility startup meetings.
 1. The first of such meetings shall be held minimum of 2 weeks prior to submitting Facility Startup Plan and shall include preliminary discussions regarding such plan and proposed sequence and schedule for the Ozone Outage Window.
 2. A second meeting to review the Facility Startup Plan following official submission in accordance with Section 01 91 14, Equipment Testing and Facility Startup.
 3. A third meeting shall be held a minimum of 2 weeks prior to the Ozone Outage Window to review the construction and startup activities which will occur during this timeframe.
- B. Agenda items shall include, but not be limited to, content of Facility Startup Plan, coordination needed between various parties in attendance, potential problems associated with startup, and sequence/schedule of activities.
- C. Attendees will include:
 1. Contractor.
 2. Contractor's designated quality control representative.
 3. OSS.

GRFF OZONE SYSTEM REPLACEMENT

4. PICS.
5. Engineer's representatives.
6. Owner's representatives.
7. Others as required by Contract Documents or as deemed necessary by Contractor and OSS.

1.09 OTHER MEETINGS

- A. In accordance with Contract Documents and as may be required by Owner and Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION**

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Preliminary Progress Schedule: Submit within 10 days after Effective Date of the Agreement.
2. Detailed Progress Schedule:
 - a. Submit initial Detailed Progress Schedule within 60 days after Effective Date of the Agreement.
 - b. Submit an Updated Progress Schedule at each update, in accordance with Article Detailed Progress Schedule.
3. Submit with Each Progress Schedule Submission:
 - a. Contractor's certification that Progress Schedule submission is actual schedule being used for execution of the Work.
 - b. Progress Schedule: Electronic copy in pdf format.
 - c. Narrative Progress Report: Electronic copy in pdf format.
4. Prior to final payment, submit a final Updated Progress Schedule.

1.02 SCHEDULE COORDINATION

- A.** Project is divided into contracts with the Ozone System Supplier (OSS) and installing Contractor with each contract awarded separately. Owner will provide the Contractor with a detailed delivery schedule from the OSS for incorporation by the Contractor into the progress schedule.

1.03 PRELIMINARY PROGRESS SCHEDULE

- A.** Show a detailed schedule, beginning with Notice to Proceed, for minimum duration of 90 days, and a summary of balance of Project through Final Completion.
- B.** Show activities including, but not limited to the following:
1. Notice to Proceed.
 2. Permits.
 3. Submittals, with review time. Contractor may use Schedule of Submittals specified in Section 01 33 00, Submittal Procedures.
 4. Early procurement activities for long lead equipment and materials.
 5. Initial Site work.
 6. Earthwork.

GRFF OZONE SYSTEM REPLACEMENT

7. Specified Work sequences and construction constraints.
 8. Contract Milestone and Completion Dates.
 9. Owner-furnished products delivery dates or ranges of dates.
 10. Major structural, mechanical, equipment, electrical, architectural, and instrumentation and control Work.
 11. System startup summary.
 12. Project close-out summary.
 13. Demobilization summary.
- C. Update Preliminary Progress Schedule monthly as part of progress payment process. Failure to do so may result in the Owner withholding all or part of the monthly progress payment until the Preliminary Progress Schedule is updated in a manner acceptable to Engineer.
- D. Format: In accordance with Article Progress Schedule—Bar Chart.

1.04 DETAILED PROGRESS SCHEDULE

- A. Submit Detailed Progress Schedule beginning with Notice to Proceed and continuing through Final Completion.
- B. Show the duration and sequences of activities required for complete performance of the Work reflecting means and methods chosen by Contractor.
- C. When accepted by Engineer, Detailed Progress Schedule will replace Preliminary Progress Schedule and become Baseline Schedule. Subsequent revisions will be considered as Updated Progress Schedules.
- D. Format: In accordance with Article Progress Schedule—Bar Chart.
- E. Update monthly to reflect actual progress and occurrences to date, including weather delays.

1.05 PROGRESS SCHEDULE—BAR CHART

- A. General: Comprehensive bar chart schedule, generally as outlined in Associated General Contractors of America (AGC) 580, “Construction Project Planning and Scheduling Guidelines.” If a conflict occurs between the AGC publication and this specification, this specification shall govern.
- B. Format:
1. Unless otherwise approved, white paper, 11-inch by 17-inch sheet size.
 2. Title Block: Show name of Project and Owner, date submitted, revision or update number, and name of scheduler.

3. Identify horizontally, across the top of the schedule, the time frame by year, month, and day.
4. Identify each activity with a unique number and a brief description of the Work associated with that activity.
5. Legend: Describe standard and special symbols used.

C. Contents:

1. Identify, in chronological order, those activities reasonably required to complete the Work, including as applicable, but not limited to:
 - a. Obtaining permits, submittals for early product procurement, and long lead time items.
 - b. Mobilization and other preliminary activities.
 - c. Initial Site work.
 - d. Specified Work sequences, constraints, and Milestones, including Substantial Completion date(s).
 - e. Subcontract Work.
 - f. Major equipment design, fabrication, factory testing, and delivery dates.
 - g. Delivery dates for Owner-furnished products, as specified in Section 01 11 00, Summary of Work.
 - h. Ozone Outage Window schedule and activities.
 - i. Sitework.
 - j. Concrete Work.
 - k. Structural steel Work.
 - l. Architectural features Work.
 - m. Conveying systems Work.
 - n. Equipment Work.
 - o. Mechanical Work.
 - p. Electrical Work.
 - q. Instrumentation and control Work.
 - r. Interfaces with Owner-furnished equipment.
 - s. Other important Work for each major facility.
 - t. Equipment and system startup and test activities.
 - u. Project closeout and cleanup.
 - v. Substantial Completion Milestones.
 - w. Demobilization.

1.06 PROGRESS OF THE WORK

A. Updated Progress Schedule shall reflect:

1. Progress of Work to within 5 working days prior to submission.
2. Approved changes in Work scope and activities modified since submission.

GRFF OZONE SYSTEM REPLACEMENT

3. Delays in Submittals or resubmittals, deliveries, or Work.
 4. Adjusted or modified sequences of Work.
 5. Other identifiable changes.
 6. Revised projections of progress and completion.
 7. Report of changed logic.
- B. Produce detailed subschedules during Project, upon request of Owner or Engineer, to further define critical portions of the Work such as facility shutdowns.
- C. If an activity is not completed by its latest scheduled completion date and this failure is anticipated to extend Contract Times (or Milestones), submit, within 7 days of such failure, a written statement as to how nonperformance will be corrected to return Project to acceptable current Progress Schedule. Actions by Contractor to complete the Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.
- D. Owner may order Contractor to increase plant, equipment, labor force, or working hours if Contractor fails to:
1. Complete a Milestone activity by its completion date.
 2. Satisfactorily execute Work as necessary to prevent delay to overall completion of Project, at no additional cost to Owner.

1.07 NARRATIVE PROGRESS REPORT

- A. Format:
1. Organize same as Progress Schedule.
 2. Identify, on a cover letter, reporting period, date submitted, and name of author of report.
- B. Contents:
1. Number of days worked over the period, work force on hand, construction equipment on hand (including utility vehicles such as pickup trucks, maintenance vehicles, stake trucks).
 2. General progress of Work, including a listing of activities started and completed over the reporting period, mobilization/demobilization of subcontractors, and major milestones achieved.
 3. Contractor's plan for management of Site (for example, lay down and staging areas, construction traffic), use of construction equipment, buildup of trade labor, and identification of potential Contract changes.
 4. Identification of new activities and sequences as a result of executed Contract changes.

5. Documentation of weather conditions over the reporting period, and any resulting impacts to the Work.
6. Description of actual or potential delays, including related causes, and the steps taken or anticipated to mitigate their impact.
7. Changes to activity logic.
8. Changes to the critical path.
9. Identification of, and accompanying reason for, any activities added or deleted since the last report.
10. Steps taken to recover the schedule from Contractor-caused delays.

1.08 SCHEDULE ACCEPTANCE

A. Engineer's acceptance will demonstrate agreement that:

1. Proposed schedule is accepted with respect to:
 - a. Contract Times, including Final Completion and all intermediate Milestones, are within the specified times.
 - b. Specified Work sequences and constraints are shown as specified.
 - c. Specified Owner-furnished Equipment or Material arrival dates, or range of dates, are included.
 - d. Access restrictions are accurately reflected.
 - e. Startup and testing times are as specified.
 - f. Submittal review times are as specified.
 - g. Startup testing duration is as specified and timing is acceptable.
2. In all other respects, Engineer's acceptance of Contractor's schedule indicates that, in Engineer's judgment, schedule represents reasonable plan for constructing Project in accordance with the Contract Documents. Engineer's review will not make any change in Contract requirements. Lack of comment on any aspect of schedule that is not in accordance with the Contract Documents will not thereby indicate acceptance of that change, unless Contractor has explicitly called the nonconformance to Engineer's attention in submittal. Schedule remains Contractor's responsibility and Contractor retains responsibility for performing all activities, for activity durations, and for activity sequences required to construct Project in accordance with the Contract Documents.

B. Unacceptable Preliminary Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process, including updating schedule on a monthly basis to reflect actual progress and occurrences to date.

- C. Unacceptable Detailed Progress Schedule:
 - 1. Make requested corrections; resubmit within 10 days.
 - 2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process.
- D. Narrative Report: All changes to activity duration and sequences, including addition or deletion of activities subsequent to Engineer's acceptance of Baseline Progress Schedule, shall be delineated in Narrative Report current with proposed Updated Progress Schedule.

1.09 ADJUSTMENT OF CONTRACT TIMES

- A. Reference General Conditions.
- B. Evaluation and reconciliation of Adjustments of Contract Times shall be based on the Updated Progress Schedule at the time of proposed adjustment or claimed delay.
- C. Schedule Contingency:
 - 1. Contingency, when used in the context of the Progress Schedule, is time between Contractor's proposed Completion Time and Contract Completion Time.
 - 2. Contingency included in Progress Schedule is a Project resource available to both Contractor and Owner to meet Contract Milestones and Contract Times. Use of Schedule contingency shall be shared to the proportionate benefit of both parties.
 - 3. Use of schedule contingency suppression techniques such as preferential sequencing and extended activity times is prohibited.
 - 4. Pursuant to Contingency sharing provisions of this specification, no time extensions will be granted, nor will delay damages be paid until a delay occurs which (i) consumes all available contingency time, and (ii) extends Work beyond the Contract Completion date.
- D. Claims Based on Contract Times:
 - 1. Where Engineer has not yet rendered formal decision on Contractor's Claim for adjustment of Contract Times, and parties are unable to agree as to amount of adjustment to be reflected in Progress Schedule, reflect an interim adjustment in the Progress Schedule as acceptable to Engineer.

GRFF OZONE SYSTEM REPLACEMENT

2. It is understood and agreed that such interim acceptance will not be binding on either Contractor or Owner, and will be made only for the purpose of continuing to schedule Work until such time as formal decision has been rendered as to an adjustment, if any, of the Contract Times.
3. Revise Progress Schedule prepared thereafter in accordance with Engineer's formal decision.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 33 00
SUBMITTAL PROCEDURES**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Action Submittal: Written and graphic information submitted by Contractor that requires Engineer's approval.
- B. Deferred Submittal: Information, in accordance with 2012 IBC submitted by Contractor for portions of design that are to be submitted to permitting agency for approval prior to installation of that portion of the Work, along with Engineer's review documentation that submittal has been found to be in general conformance with Project's design.
- C. Informational Submittal: Information submitted by Contractor that requires Engineer's review and determination that submitted information is in accordance with the Conditions of the Contract.

1.02 PROCEDURES

- A. Electronic Submittals: Submittals shall, unless specifically accepted, be made in electronic format.
 - 1. Each submittal shall be an electronic file in Adobe Acrobat Portable Document Format (PDF). Use the latest version available at time of execution of the Agreement.
 - 2. Electronic files that contain more than 10 pages in PDF format shall contain internal bookmarking from an index page to major sections of the document.
 - 3. PDF files shall be set to open "Bookmarks and Page" view.
 - 4. Add general information to each PDF file, including title, subject, author, and keywords.
 - 5. PDF files shall be set up to print legibly at 8.5-inch by 11-inch, 11-inch by 17-inch, or 22-inch by 34-inch. No other paper sizes will be accepted.
 - 6. Submit new electronic files for each resubmittal.
 - 7. Include a copy of the Transmittal of Contractor's Submittal form, located at end of section, with each electronic file.
 - 8. Engineer will reject submittal that is not electronically submitted in accordance with the requirements of this section, unless specifically accepted.

GRFF OZONE SYSTEM REPLACEMENT

9. Provide Engineer with authorization to reproduce and distribute each file as many times as necessary for Project documentation.
10. Detailed procedures for handling electronic submittals will be discussed at the preconstruction conference.

B. Transmittal of Submittal:

1. Contractor shall:
 - a. Review each submittal and check for compliance with Contract Documents.
 - b. Stamp each submittal with uniform approval stamp before submitting to Engineer.
 - 1) Stamp to include Project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying submittal has been reviewed, checked, and approved for compliance with Contract Documents.
 - 2) Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
2. Complete, sign, and transmit with each submittal package, one Transmittal of Contractor's Submittal form attached at end of this section.
3. Identify each submittal with the following:
 - a. Submittal numbering as follows:
 - 1) A simple numeric chronology starting with the number (01) and continuing; the specification section being submitted on; the sub-item number being submitted; the resubmittal number; and a brief description of the submittal. Refer to the following example:
 - a) 01-402700-1-0-SST Ball Valves.
 - b) In this case, the (01) represents the simple numeric chronology, 402700 represents the specification section being submitted on, (1) represents the section sub-item being submitted on, (0) represents the resubmittal number, finishing with the simple description.
 - b. Specification section and paragraph to which submittal applies.
 - c. Project title and Engineer's project number.
 - d. Date of transmittal.
 - e. Names of Contractor, Subcontractor or Supplier, and manufacturer as appropriate.
4. Identify and describe each deviation or variation from Contract Documents.

C. Format:

1. Do not base Shop Drawings on reproductions of Contract Documents.
2. Package submittal information by individual specification section. Do not combine different specification sections together in submittal package, unless otherwise directed in specification.
3. Present in a clear and thorough manner and in sufficient detail to show kind (make and model), size, arrangement, and function of components, materials, quantity, and devices, and compliance with Contract Documents.
4. Index with labeled tab dividers in orderly manner.

D. Timeliness: Schedule and submit in accordance Schedule of Submittals and requirements of individual specification sections.

E. Processing Time:

1. Time for review shall commence on Engineer's receipt of submittal.
2. Engineer will act upon Contractor's submittal and transmit response to Contractor not later than 30 days after receipt, unless otherwise specified.
3. Resubmittals will be subject to same review time.
4. No adjustment of Contract Times or Price will be allowed as a result of delays in progress of Work caused by rejection and subsequent resubmittals.

F. Resubmittals:

1. Clearly identify each correction or change made.
2. All resubmittals shall include the complete original submittal. Resubmittals which are partially complete will be sent back to the Contractor for correction. The timeline for review will not begin until a resubmittal has been accepted as being complete.
3. Furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
4. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, unless the need for such change is beyond the control of Contractor.

GRFF OZONE SYSTEM REPLACEMENT

G. Incomplete Submittals:

1. Engineer will return entire submittal for Contractor's revision if preliminary review deems it incomplete.
2. When any of the following are missing, submittal will be deemed incomplete:
 - a. Contractor's review stamp; completed and signed.
 - b. Transmittal of Contractor's Submittal; completed and signed.

H. Submittals not Required by Contract Documents: Will not be reviewed and will be returned stamped "Not Subject to Review."

1.03 ACTION SUBMITTALS

A. Prepare and submit Action Submittals required by individual specification sections.

B. Shop Drawings:

1. Identify and Indicate:
 - a. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.
 - b. Equipment and Component Title: Identical to title shown on the Drawings.
 - c. Critical field dimensions and relationships to other critical features of Work. Note dimensions established by field measurement.
 - d. Project-specific information drawn accurately to scale.
2. Manufacturer's standard schematic drawings and diagrams as follows:
 - a. Modify to delete information that is not applicable to the Work.
 - b. Supplement standard information to provide information specifically applicable to the Work.
3. Product Data: Provide as specified in individual specifications.
4. Foreign Manufacturers: When proposed, include names and addresses of at least two companies that maintain technical service representatives close to Project.

C. Samples:

1. Copies: Two, unless otherwise specified in individual specifications.

2. Preparation:
 - a. Mount, display, or package Samples in manner specified to facilitate review of quality. Attach label on unexposed side that includes the following:
 - 1) Manufacturer name.
 - 2) Model number.
 - 3) Material.
 - 4) Sample source.
3. Manufacturer's Color Chart: Units or sections of units showing full range of colors, textures, and patterns available.
4. Full-size Samples:
 - a. Size as indicated in individual specification section.
 - b. Prepared from same materials to be used for the Work.
 - c. Cured and finished in manner specified.
 - d. Physically identical with product proposed for use.

D. Action Submittal Dispositions:

1. Engineer will review, comment, stamp, and distribute as noted:
 - a. Approved:
 - 1) Contractor may incorporate product(s) or implement Work covered by submittal.
 - 2) Distribution: Electronic.
 - b. Approved as Noted:
 - 1) Contractor may incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
 - 2) Distribution: Electronic.
 - c. Partial Approval, Resubmit as Noted:
 - 1) Make corrections or obtain missing portions, and resubmit.
 - 2) Except for portions indicated, Contractor may begin to incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
 - 3) Distribution: Electronic.
 - d. Revise and Resubmit:
 - 1) Contractor may not incorporate product(s) or implement Work covered by submittal.
 - 2) Distribution: Electronic.

GRFF OZONE SYSTEM REPLACEMENT

1.04 INFORMATIONAL SUBMITTALS

A. General:

1. Refer to individual specification sections for specific submittal requirements.
2. Engineer will review each submittal. If submittal meets conditions of the Contract, Engineer will forward copy to appropriate parties. If Engineer determines submittal does not meet conditions of the Contract and is therefore considered unacceptable, Engineer will retain one copy and return remaining copy with review comments to Contractor, and require that submittal be corrected and resubmitted.

B. Certificates:

1. General:
 - a. Provide notarized statement that includes signature of entity responsible for preparing certification.
 - b. Signed by officer or other individual authorized to sign documents on behalf of that entity.
2. Welding: In accordance with individual specification sections.
3. Installer: Prepare written statements on manufacturer's letterhead certifying installer complies with requirements as specified in individual specification section.
4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in individual specification sections.
6. Manufacturer's Certificate of Compliance: In accordance with Section 01 61 00, Common Product Requirements.
7. Manufacturer's Certificate of Proper Installation: In accordance with Section 01 43 33, Manufacturers' Field Services.

C. Construction Photographs: In accordance with Section 01 31 13, Project Coordination, and as may otherwise be required in Contract Documents.

D. Closeout Submittals: In accordance with Section 01 77 00, Closeout Procedures.

E. Contractor-Design Data (related to temporary construction):

1. Written and graphic information.
2. List of assumptions.
3. List of performance and design criteria.

4. Summary of loads or load diagram, if applicable.
 5. Calculations.
 6. List of applicable codes and regulations.
 7. Name and version of software.
 8. Information requested in individual specification section.
- F. Deferred Submittals: See the Drawings for list of deferred submittals.
1. Contractor-design data related to permanent construction:
 - a. List of assumptions.
 - b. List of performance and design criteria.
 - c. Summary of loads or load diagram, if applicable.
 - d. Calculations.
 - e. List of applicable codes and regulations.
 - f. Name and version of design software.
 - g. Factory test results.
 - h. Informational submittals requested in individual specification section.
 2. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit calculations and test results of Contractor-designed components for review by Engineer. Documentation of review and indication of compliance with general design intent and Project criteria provided on Engineer's comment form as meets conditions of the Contract, along with completed submittal, shall be filed with permitting agency by Contractor and approved by permitting agency prior to installation.
- G. Manufacturer's Instructions: Written or published information that documents manufacturer's recommendations, guidelines, and procedures in accordance with individual specification section.
- H. Payment:
1. Application for Payment: In accordance with Section 01 29 00, Payment Procedures.
 2. Schedule of Values: In accordance with Section 01 29 00, Payment Procedures.

GRFF OZONE SYSTEM REPLACEMENT

I. Schedules:

1. Schedule of Submittals: Prepare separately or in combination with Progress Schedule as specified in Section 01 32 00, Construction Progress Documentation.
 - a. Show for each, at a minimum, the following:
 - 1) Specification section number.
 - 2) Identification by numbering and tracking system as specified under Paragraph Transmittal of Submittal.
 - 3) Estimated date of submission to Engineer, including reviewing and processing time.
 - b. On a monthly basis, submit updated Schedule of Submittals to Engineer if changes have occurred or resubmittals are required.
2. Progress Schedules: In accordance with Section 01 32 00, Construction Progress Documentation.

J. Special Guarantee: Supplier's written guarantee as required in individual specification sections.

K. Statement of Qualification: Evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty Subcontractor, trade, Specialist, consultant, installer, and other professionals.

L. Submittals Required by Laws, Regulations, and Governing Agencies:

1. Promptly submit promptly notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
2. Transmit to Engineer for Owner's records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.

M. Test, Evaluation, and Inspection Reports:

1. General: Shall contain signature of person responsible for test or report.
2. Factory:
 - a. Identification of product and specification section, type of inspection or test with referenced standard or code.
 - b. Date of test, Project title and number, and name and signature of authorized person.
 - c. Test results.
 - d. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.

- e. Provide interpretation of test results, when requested by Engineer.
- f. Other items as identified in individual specification sections.
- 3. Field:
 - a. As a minimum, include the following:
 - 1) Project title and number.
 - 2) Date and time.
 - 3) Record of temperature and weather conditions.
 - 4) Identification of product and specification section.
 - 5) Type and location of test, Sample, or inspection, including referenced standard or code.
 - 6) Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
 - 7) If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
 - 8) Provide interpretation of test results, when requested by Engineer.
 - 9) Other items as identified in individual specification sections.

N. Testing and Startup Data: In accordance with Section 01 91 14, Equipment Testing and Facility Startup.

O. Training Data: In accordance with Section 01 43 33, Manufacturers' Field Services.

1.05 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this specification:

- 1. Transmittal of Contractor's Submittal.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

GRFF OZONE SYSTEM REPLACEMENT

TRANSMITTAL OF CONTRACTOR'S SUBMITTAL (ATTACH TO EACH SUBMITTAL)	
DATE: _____	
TO: _____ _____ _____ _____ _____ FROM: _____ Contractor _____ _____ _____	Submittal No.: _____ ☐ New Submittal ☐ Resubmittal Project: _____ Project No.: _____ Specification Section No.: _____ (Cover only one section with each transmittal) Schedule Date of Submittal: _____ _____
SUBMITTAL TYPE:	☐ Shop Drawing ☐ Sample ☐ Informational ☐ Deferred

The following items are hereby submitted:

Number of Copies	Description of Item Submitted (Type, Size, Model Number, Etc.)	Spec. and Para. No.	Drawing or Brochure Number	Contains Variation to Contract	
				No	Yes

Contractor hereby certifies that (i) Contractor has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By: _____
 Contractor (Authorized Signature)

SECTION 01 43 33
MANUFACTURERS' FIELD SERVICES

PART 1 GENERAL

1.01 DEFINITIONS

- A. Person-Day: One person for 8 hours within regular Contractor working hours.

1.02 SUBMITTALS

- A. Informational Submittals:
 - 1. Training Schedule: Submit, in accordance with requirements of this Specification, not less than 15 days prior to start of equipment installation and revise as necessary for acceptance.
 - 2. Lesson Plan: Submit, in accordance with requirements of this Specification, proposed lesson plan not less than 21 days prior to scheduled training and revise as necessary for acceptance.

1.03 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

- A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer. Additional qualifications may be specified in the individual specification section.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

- A. Furnish manufacturers' services, when required by an individual specification section, to meet the requirements of this section.
- B. Where time is necessary in excess of that stated in these specifications for manufacturers' services, or when a minimum time is not specified, time required to perform specified services shall be considered incidental.
- C. Schedule manufacturer' services to avoid conflict with other onsite testing or other manufacturers' onsite services.

GRFF OZONE SYSTEM REPLACEMENT

- D. Determine, before scheduling services, that conditions necessary to allow successful testing have been met.
- E. Only those days of service approved by Engineer will be credited to fulfill specified minimum services.
- F. When specified in individual specification sections, manufacturer's onsite services shall include:
 - 1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation, or application procedures.
 - 2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
 - 3. Providing, on a daily basis, copies of manufacturers' representatives field notes and data to Engineer.
 - 4. Revisiting the Site as required to correct problems and until installation and operation are acceptable to Engineer.
 - 5. Resolution of assembly or installation problems attributable to or associated with respective manufacturer's products and systems.
 - 6. Assistance during functional and performance testing, and facility startup and evaluation.
 - 7. Training of Owner's personnel in the operation and maintenance of respective product as required.

3.02 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

- A. When so specified, a Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this section, shall be completed and signed by equipment manufacturer's representative.
- B. Such form shall certify signing party is a duly authorized representative of manufacturer, is empowered by manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to ensure equipment is complete and operational.

3.03 TRAINING

- A. General:
 - 1. Furnish manufacturers' representatives for detailed classroom and hands-on training to Owner's personnel on operation and maintenance of specified product (system, subsystem, component) and as may be required in applicable Specifications.

2. Furnish trained, articulate English language speaking personnel to coordinate and expedite training, to be present during training coordination meetings with Owner, and familiar with operation and maintenance manual information specified in Section 01 78 23, Operation and Maintenance Data.
3. Manufacturer's representative shall be familiar with facility operation and maintenance requirements as well as with specified equipment.
4. Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.

B. Training Schedule:

1. List specified equipment and systems that require training services and show:
 - a. Respective manufacturer.
 - b. Estimated dates for installation completion.
 - c. Estimated training dates.
2. Allow for multiple sessions when several shifts are involved.
3. Adjust schedule to ensure training of appropriate personnel as deemed necessary by Owner, and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.
4. Coordinate with Section 01 32 00, Construction Progress Documentation, and Section 01 91 14, Equipment Testing and Facility Startup.

C. Lesson Plan:

1. When manufacturer or vendor training of Owner personnel is specified, prepare a lesson plan for each required course containing the following minimum information:
 - a. Title and objectives.
 - b. Recommended attendees (such as, managers, engineers, operators, maintenance).
 - c. Course description, outline of course content, and estimated class duration.
 - d. Format (such as, lecture, self-study, demonstration, hands-on).
 - e. Instruction materials and equipment requirements.
 - f. Resumes of instructors providing training.

GRFF OZONE SYSTEM REPLACEMENT

3.04 SUPPLEMENT

A. The supplement listed below, following “End of Section,” is a part of this specification:

1. Manufacturer’s Certificate of Proper Installation.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

OWNER _____ EQPT SERIAL NO: _____

EQPT TAG NO: _____ EQPT/SYSTEM: _____

PROJECT NO: _____ SPEC. SECTION: _____

I hereby certify that 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 and mechanical connections meet quality and safety standards.
- ☐ All applicable safety equipment has been properly installed.
- ☐ Functional tests.
- ☐ System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Note: Attach any performance test documentation from manufacturer.

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 their equipment and (iii) authorized to make recommendations required to ensure equipment 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: _____, 20____

Manufacturer: _____

By Manufacturer's Authorized Representative: _____

(Authorized Signature)

**SECTION 01 45 16.13
CONTRACTOR QUALITY CONTROL**

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
 - a. D3740, Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
 - b. E329, Use in the Evaluation of Testing and Inspection Agencies as Used in Construction.

1.02 DEFINITIONS

A. Contractor Quality Control (CQC): The means by which Contractor ensures that the construction, to include that performed by subcontractors and suppliers, complies with the requirements of the Contract.

1.03 SUBMITTALS

A. Informational Submittals:

1. CQC Plan: Submit, not later than 30 days after receipt of Notice to Proceed.
2. CQC Report: Submit, weekly, an original and one copy in report form.

1.04 OWNER'S QUALITY ASSURANCE

A. All Work is subject to Owner's quality assurance inspection and testing at all locations and at all reasonable times before acceptance to ensure strict compliance with the terms of the Contract Documents.

B. Owner's quality assurance inspections and tests are for the sole benefit of Owner and do not:

1. Relieve Contractor of responsibility for providing adequate quality control measures.
2. Relieve Contractor of responsibility for damage to or loss of the material before acceptance.
3. Constitute or imply acceptance.
4. Affect the continuing rights of Owner after acceptance of the completed Work.

GRFF OZONE SYSTEM REPLACEMENT

- C. The presence or absence of a quality assurance inspector does not relieve Contractor from any Contract requirement.
- D. Promptly furnish all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by Engineer.
- E. Owner may charge Contractor for any additional cost of inspection or test when Work is not ready at the time specified by Contractor for inspection or test, or when prior rejection makes re-inspection or retest necessary. Quality assurance inspections and tests will be performed in a manner that will not unnecessarily delay the Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Maintain an adequate inspection system and perform such inspections as will ensure that the Work conforms to the Contract Documents.
- B. Maintain complete inspection records and make them available at all times to Owner and Engineer.
- C. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the Contract Documents. The system shall cover all construction and demolition operations, both onsite and offsite, including Work by subcontractors, fabricators, suppliers and purchasing agents, and shall be keyed to the proposed construction sequence.

3.02 COORDINATION MEETING

- A. After the Preconstruction Conference, but before start of construction, and prior to acceptance of the CQC Plan, schedule a meeting with Engineer and Owner to discuss the quality control system.
- B. Develop a mutual understanding of the system details, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite Work, and the interrelationship of Contractor's management and control with the Owner's Quality Assurance.
- C. There may be occasions when subsequent conferences may be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures that may require corrective action by Contractor.

3.03 QUALITY CONTROL ORGANIZATION

A. CQC System Manager:

1. Designate an individual within Contractor's organization who will be responsible for overall management of CQC and have the authority to act in CQC matters for the Contractor.
2. CQC System Manager may perform other duties on the Project.
3. CQC System Manager shall be an experienced construction person, with a minimum of 3 years construction experience on similar type Work.
4. CQC System Manager shall report to the Contractor's project manager or someone higher in the organization. Project manager in this context shall mean the individual with responsibility for the overall quality and production management of the Project.
5. CQC System Manager shall be onsite during construction; periods of absence may not exceed 2 weeks at any one time.
6. Identify an alternate for CQC System Manager to serve with full authority during the System Manager's absence. The requirements for the alternate will be the same as for designated CQC System Manager.

B. CQC Staff:

1. Designate a CQC staff, available at the Site at all times during progress, with complete authority to take any action necessary to ensure compliance with the Contract. CQC staff members shall be subject to acceptance by Engineer.
2. CQC staff shall take direction from CQC System Manager in matters pertaining to QC.
3. CQC staff must be of sufficient size to ensure adequate QC coverage of Work phases, work shifts, and work crews involved in the construction. These personnel may perform other duties, but must be fully qualified by experience and technical training to perform their assigned QC responsibilities and must be allowed sufficient time to carry out these responsibilities.
4. The actual strength of the CQC staff may vary during any specific Work period to cover the needs of the Project. Add additional staff when necessary for a proper CQC organization.

C. Organizational Changes: Obtain Engineer's acceptance before replacing any member of the CQC staff. Requests for changes shall include name, qualifications, duties, and responsibilities of the proposed replacement.

3.04 QUALITY CONTROL PHASING

- A. CQC shall include at least three phases of control to be conducted by CQC System Manager for all definable features of Work, as follows:
1. Preparatory Phase:
 - a. Notify Owner at least 48 hours in advance of beginning any of the required action of the preparatory phase.
 - b. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The CQC System Manager shall instruct applicable CQC staff as to the acceptable level of workmanship required in order to meet Contract requirements.
 - c. Document the results of the preparatory phase meeting by separate minutes prepared by the CQC System Manager and attached to the QC report.
 - d. Perform prior to beginning Work on each definable feature of Work:
 - 1) Review applicable Contract Specifications.
 - 2) Review applicable Contract Drawings.
 - 3) Verify that all materials and/or equipment have been tested, submitted, and approved.
 - 4) Verify that provisions have been made to provide required control inspection and testing.
 - 5) Examine the Work area to verify that all required preliminary Work has been completed and is in compliance with the Contract.
 - 6) Perform a physical examination of required materials, equipment, and sample Work to verify that they are on hand, conform to approved Shop Drawing or submitted data, and are properly stored.
 - 7) Review the appropriate activity hazard analysis to verify safety requirements are met.
 - 8) Review procedures for constructing the Work, including repetitive deficiencies.
 - 9) Document construction tolerances and workmanship standards for that phase of the Work.
 - 10) Check to verify that the plan for the Work to be performed, if so required, has been accepted by Engineer.

2. Initial Phase:
 - a. Accomplish at the beginning of a definable feature of Work:
 - 1) Notify Owner at least 48 hours in advance of beginning the initial phase.
 - 2) Perform prior to beginning Work on each definable feature of Work:
 - a) Review minutes of the preparatory meeting.
 - b) Check preliminary Work to verify compliance with Contract requirements.
 - c) Verify required control inspection and testing.
 - d) Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Comparison with sample panels is appropriate.
 - e) Resolve all differences.
 - f) Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
 - 3) Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the QC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.
 - 4) The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.
3. Follow-up Phase:
 - a. Perform daily checks to verify continuing compliance with Contract requirements, including control testing, until completion of the particular feature of Work.
 - b. Daily checks shall be made a matter of record in the CQC documentation and shall document specific results of inspections for all features of Work for the day or shift.
 - c. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of Work that will be affected by the deficient Work. Constructing upon or concealing nonconforming Work will not be allowed.
4. Additional Preparatory and Initial Phases: Additional preparatory and initial phases may be conducted on the same definable features of Work as determined by Owner if the quality of ongoing Work is unacceptable; or if there are changes in the applicable QC staff or in the onsite production supervision or work crew; or if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

3.05 CONTRACTOR QUALITY CONTROL PLAN

A. General:

1. Plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used.
2. An interim plan for the first 30 days of operation will be considered.
3. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of Work to be started.
4. Work outside of the features of Work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of Work to be started.

B. Content:

1. Plan shall cover the intended CQC organization for the entire Contract and shall include the following, as a minimum:
 - a. Organization: Description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff will implement the three-phase control system (see Article Quality Control Phasing) for all aspects of the Work specified.
 - b. CQC Staff: The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a QC function.
 - c. Letters of Authority: A copy of a letter to the CQC System Manager signed by an authorized official of the firm, describing the responsibilities and delegating sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop Work which is not in compliance with the Contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities and responsibilities. Copies of these letters will also be furnished to Owner.
 - d. Submittals: Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers and purchasing agents.
 - e. Testing: Control, verification and acceptance testing procedures for each specific test to include the test name, frequency, specification paragraph containing the test requirements, the personnel and laboratory responsible for each type of test, and an estimate of the number of tests required.

- f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests, including documentation.
 - g. Procedures for tracking deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.
 - h. Reporting procedures, including proposed reporting formats; include a copy of the CQC report form.
- C. Acceptance of Plans: Acceptance of the Contractor's basic and addendum CQC plans is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. Owner reserves the right to require Contractor to make changes in the CQC plan and operations including removal of personnel, as necessary, to obtain the quality specified.
- D. Notification of Changes: After acceptance of the CQC plan, Contractor shall notify Engineer, in writing, a minimum of 7 calendar days prior to any proposed change. Proposed changes are subject to acceptance by Engineer.

3.06 CONTRACTOR QUALITY CONTROL REPORT

- A. As a minimum, prepare a CQC report for every 7 calendar days. Account for all days throughout the life of the Contract. Reports shall be signed and dated by CQC System Manager. Include copies of test reports and copies of reports prepared by QC staff.
- B. Maintain current records of quality control operations, activities, and tests performed, including the Work of subcontractors and suppliers.
- C. Records shall be on an acceptable form and shall be a complete description of inspections, the results of inspections, daily activities, tests, and other items, including but not limited to the following:
 - 1. Contractor/subcontractor and their areas of responsibility.
 - 2. Operating plant/equipment with hours worked, idle, or down for repair.
 - 3. Work performed today, giving location, description, and by whom. When a network schedule is used, identify each phase of Work performed each day by activity number.
 - 4. Test and/or control activities performed with results and references to specifications/plan requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
 - 5. Material received with statement as to its acceptability and storage.
 - 6. Identify submittals reviewed, with Contract reference, by whom, and action taken.

GRFF OZONE SYSTEM REPLACEMENT

7. Offsite surveillance activities, including actions taken.
8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
9. List instructions given/received and conflicts on the Drawings and/or Specifications.
10. Contractor's verification statement.
11. Indicate a description of trades working on the Project; the number of personnel working; weather conditions encountered; and any delays encountered.
12. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in file work and workmanship comply with the Contract.

3.07 SUBMITTAL QUALITY CONTROL

- A. Submittals shall be as specified in Section 01 33 00, Submittal Procedures. The CQC organization shall be responsible for certifying that all submittals are in compliance with the Contract requirements. Owner will furnish copies of test report forms upon request by Contractor. Contractor may use other forms as approved.

3.08 TESTING QUALITY CONTROL

- A. Testing Procedure:
 1. Perform tests specified or required to verify that control measures are adequate to provide a product which conforms to Contract requirements. Perform the following activities and record the following data:
 - a. Verify testing procedures comply with contract requirements.
 - b. Verify facilities and testing equipment are available and comply with testing standards.
 - c. Check test instrument calibration data against certified standards.
 - d. Verify recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
 - e. Documentation:
 - 1) Record results of all tests taken, both passing and failing, on the CQC report for the date taken.
 - 2) Include specification paragraph reference, location where tests were taken, and the sequential control number identifying the test.
 - 3) Actual test reports may be submitted later, if approved by Engineer, with a reference to the test number and date taken.

- 4) Provide directly to Engineer an information copy of tests performed by an offsite or commercial test facility. Test results shall be signed by an engineer registered in the state where the tests are performed.
- 5) Failure to submit timely test reports, as stated, may result in nonpayment for related Work performed and disapproval of the test facility for this Contract.

B. Testing Laboratories: Laboratory facilities, including personnel and equipment, utilized for testing soils, concrete, asphalt and steel shall meet criteria detailed in ASTM D3740 and ASTM E329, and be accredited by the American Association of Laboratory Accreditation (AALA), National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), the American Association of State Highway and Transportation Officials (AASHTO), or other approved national accreditation authority. Personnel performing concrete testing shall be certified by the American Concrete Institute (ACI).

3.09 COMPLETION INSPECTION

- A. CQC System Manager shall conduct an inspection of the Work at the completion of all Work or any milestone established by a completion time stated in the Contract.
- B. Punchlist:
 1. CQC System Manager shall develop a punchlist of items which do not conform to the Contract requirements.
 2. Include punchlist in the CQC report, indicating the estimated date by which the deficiencies will be corrected.
 3. CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected and so notify the Owner.
 4. These inspections and any deficiency corrections required will be accomplished within the time stated for completion of the entire Work or any particular increment thereof if the Project is divided into increments by separate completion dates.

END OF SECTION

SECTION 01 45 33
SPECIAL INSPECTION, OBSERVATION, AND TESTING

PART 1 GENERAL

1.01 SUMMARY

- A. This section covers requirements for Special Inspection, Observation, and Testing required in accordance with Chapter 17 of the 2021 IBC and is in addition to and supplements requirements included in Statement of Special Inspections shown in supplement located at end of this section.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
 - 2. International Code Council (ICC):
 - a. International Building Code (IBC).
 - b. Evaluation Service (ICC-ES) Reports and Legacy Reports.

1.03 DEFINITIONS

- A. Agencies and Personnel:
 - 1. Agency Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.
 - 2. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved.
 - 3. Registered Design Professional in Responsible Charge: An individual who is registered or licensed to practice their respective design profession as defined by statutory requirements of professional registration laws of state or jurisdiction in which Project is to be constructed.
 - 4. Special Inspector: Qualified person employed by Owner who will demonstrate competence to the satisfaction of AHJ for inspection of a particular type of construction or operation requiring Special Inspection.

GRFF OZONE SYSTEM REPLACEMENT

B. Nonstructural Components:

1. Architectural Component Supports: Structural members or assemblies of members which transmit loads and forces from architectural systems or components to structure, including braces, frames, struts, and attachments.
2. Electrical Component Supports: Structural members or assemblies which transmit loads and forces from electrical equipment to structure, including braces, frames, legs, pedestals, and tethers, as well as elements forged or cast as part of component for anchorage.
3. Mechanical and Plumbing Component Supports: Structural members or assemblies which transmit loads and forces from mechanical or plumbing equipment to structure, including braces, frames, skirts, legs, saddles, pedestals, snubbers, and tethers, as well as elements forged or cast as part of component for anchorage.

C. Professional Observation:

1. Does not include or waive responsibility for required Special Inspection or inspections by building official.
2. Geotechnical Observation: Visual observation of selected subgrade bearing surfaces and installation of deep foundation elements by a registered design professional for general conformance to Contract Documents.
3. Requirements are indicated on Statement of Special Inspections provided in supplement located at the end of this section.
4. Structural Observation: Visual observation of structural system(s) by a registered design professional for general conformance to Contract Documents.

D. Special Inspection:

1. Special Inspection, Continuous: Full-time observation of work requiring Special Inspection by an approved Special Inspector who is present in area where the Work is being performed.
2. Special Inspection: Inspection required of materials, installation, fabrication, erection, or placement of components and connections requiring special expertise to ensure compliance with approved Contract Documents and referenced standards.
3. Special Inspection, Periodic: Part-time or intermittent observation of the Work requiring Special Inspection by an approved Special Inspector who is present in area where the Work has been or is being performed, and at completion of the Work.

- E. Statement of Special Inspections: Detailed written procedure contained in supplement located at end of this section establishing systems and components subject to Special Inspection, Observation, and Testing during construction, type and frequency of testing, extent and duration of Special Inspection, and reports to be completed and distributed by Special Inspector.

1.04 SUBMITTALS

A. Informational Submittals:

1. Contractor's Statement of Responsibility: Form shall be completed by entity responsible for construction of components listed in Statement of Special Inspections. Refer to Article Supplements located at end of section.
2. Fabricator's Certificate of Compliance: Form shall be completed by entity responsible for shop fabrication of structural load-bearing members and assemblies. Refer to Article Supplements located at end of section.

1.05 STATEMENT OF SPECIAL INSPECTIONS REQUIREMENTS

A. Statement of Special Inspections:

1. As included in supplement located at the end of this section and in support of building permit application, Project-specific requirements were prepared by Registered Design Professional in Responsible Charge. The following identifies elements of inspection, observation, and testing program to be followed in construction of the Work:
 - a. Designated components that are subject to Special Inspection for lateral load resistance.
 - b. Special Inspection and testing required by IBC 1705 and other applicable sections and referenced standards therein.
 - c. Type and frequency of Special Inspection required.
 - d. Type and frequency of testing required.
 - e. Required frequency and distribution of testing and Special Inspection reports to be distributed by Special Inspector to Engineer, Contractor, building official, and Owner.

- B. Special Inspection and associated testing of shop fabrication and field construction will be performed by an approved accredited independent agency or by Authority Having Jurisdiction's (AHJ) approved, qualified inspection staff. Owner will secure and pay for services of agency to perform Special Inspection and associated testing.

GRFF OZONE SYSTEM REPLACEMENT

- C. Code required Special Inspection with associated testing, as provided in Statement of Special Inspections in supplement located at the end of this section and further provided in this section, is for benefit of Owner and does not:
 - 1. Relieve Contractor of responsibility for providing adequate quality control measures.
 - 2. Relieve Contractor of responsibility for damage to or loss of material before acceptance.
 - 3. Constitute or imply acceptance.
 - 4. Affect continuing rights of Owner after acceptance of completed Work.
- D. The presence or absence of code required Special Inspector does not relieve Contractor from Contract requirements.
- E. Contractor is responsible for additional costs associated with Special Inspection and Testing when Work is not ready at time identified by Contractor and Special Inspectors are onsite, but not able to provide contracted services.
- F. Contractor is responsible for associated costs for additional Special Inspection and Testing by Special Inspectors required because of rejection of materials of in place Work that cannot be made compliant to Contract Document without additional inspections and testing.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Requirements of the Statement of Special Inspections are provided by the Owner. All other testing and inspections, unless noted otherwise, are provided by Contractor.
- B. Provide access to shop or Site for Special Inspection and Testing requirements.
- C. Notify Owner and Engineer in advance of required Special Inspection no later than 48 hours prior to date of Special Inspection.
- D. Provide access for Special Inspector to construction documents.
- E. Retain special inspection records onsite to be readily available for review.

- F. Cooperate with Special Inspector and provide safe access to the Work to be inspected.
- G. Submit Fabricator's Certificates of Compliance for approved fabricators.
- H. Provide reasonable auxiliary services as requested by the Special Inspector. Auxiliary services required include, but not limited to:
 - 1. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests to assist the Special Inspector in performing test or inspections.
 - 2. Providing storage space for the Special Inspector's exclusive use, such as for storing and curing concrete test samples and delivery of samples to testing laboratories.
 - 3. Providing the Special Inspector with access to all approved submittals.
 - 4. Providing security and protection of samples and test equipment at the Project Site.
 - 5. Provide samples of materials to be tested in required quantities.
- I. Materials and systems shall be inspected during placement where Continuous Special Inspection is required.
- J. Where Periodic Special Inspection is indicated in the Statement of Special Inspections:
 - 1. Schedule inspections for either during or at completion of their placement or a combination or both.
 - 2. Schedule periodically inspected Work (either inspected during or after its placement) so that corrections can be completed and re-inspected before Work is inaccessible.
 - 3. Sampling a portion of the Work is not allowed. Schedules shall provide for inspection of all Work requiring periodic inspection.

3.02 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are a part of this specification:
 - 1. Contractor's Statement of Responsibility.
 - 2. Fabricator's Certificate of Compliance.
 - 3. Statement of Special Inspections.
 - 4. IBC Required Special Inspection Tables.

END OF SECTION

CONTRACTOR'S STATEMENT OF RESPONSIBILITY

 (Project)

 (Name of Contracting Company)

 (Business Address)

 (_____) _____
 (Telephone)

 (_____) _____
 (Fax)

I, (We) hereby certify that I am (we are) aware of the Special Inspection and Testing and component certification requirements contained in Contract Documents for this Project for components including architectural, mechanical, and electrical components, as listed in Statement of Special Inspections in supplement located at the end of this section, and that:

- I, (We) aware of the systems and the requirements of the special inspection and acknowledge our responsibility in the implementation of the Statement of Special Inspections for the construction of the following systems:

Facility	Specification	Lateral Force-Resisting System

- and I, (We) are responsible for construction of the following components:

Facility	Component

GRFF OZONE SYSTEM REPLACEMENT

3. Control of this Work will be exercised to obtain conformance with Contract Documents approved by building official.
4. Procedures within the Contractor's organization to be used for exercising control of the Work, method and frequency of reporting, and distribution of reports required under Statement of Special Inspections for Project are attached to this statement.
5. I, (We) will provide 48-hour notification to Engineer and approved inspection agency as required for structural tests and Special Inspection for Project.
6. The following person is hereby identified as exercising control over requirements of this section for the Work designated above:

Name: _____

Qualifications: _____

(Print name and official title of person signing this form)

Signed by: _____

Date: _____

Project Name: _____

FABRICATOR’S CERTIFICATE OF COMPLIANCE

Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per IBC Section 1704.2.5 must submit Fabricator’s Certificate of Compliance at the completion of fabrication.

(Project)

(Fabricator’s Name)

(Business Address)

(Certification or Approval Agency)

(Certification Number)

(Date of Last Audit or Approval)

Description of structural members and assemblies that have been fabricated:

I hereby certify that items described above were fabricated in strict accordance with approved construction documents.

(Name and Title) type or print

(Signature and Date)

Attach copies of fabricator’s certification or building code evaluation service report and fabricator’s quality control manual.

STATEMENT OF SPECIAL INSPECTIONS

GENERAL NOTES

1. THE STATEMENT OF SPECIAL INSPECTIONS PROVIDE PROJECT COMPLIANCE WITH THE PROVISIONS OF THE 2021 INTERNATIONAL BUILDING CODE (IBC) CHAPTER 17 FOR SPECIAL INSPECTION, STRUCTURAL OBSERVATION, AND TESTING FOR WIND AND SEISMIC RESISTANCE AS APPLICABLE. EXCEPT WHERE OTHERWISE NOTED, THIS INSPECTION IS OWNER FURNISHED.
2. STANDARD SPECIAL INSPECTION REQUIREMENTS FOR NONSTRUCTURAL COMPONENTS ARE CONTAINED IN TABLE 1.
3. STANDARD SPECIAL INSPECTION REQUIREMENTS FOR STRUCTURAL COMPONENTS, REGARDLESS OF WIND OR SEISMIC DESIGN CATEGORIES, ARE CONTAINED IN TABLE 2. STANDARD TESTING REQUIREMENTS FOR STRUCTURAL COMPONENTS ARE CONTAINED IN TABLE 3.
4. PROJECT SPECIFIC REQUIREMENTS FOR STRUCTURES ASSIGNED TO SEISMIC DESIGN CATEGORIES C, D, E, OR F ARE CONTAINED IN TABLE 4. ADDITIONAL TESTING REQUIREMENTS FOR STRUCTURAL RESISTANCE ARE CONTAINED IN TABLE 6.
5. FOR ADDITIONAL REQUIREMENTS, REFER TO SPECIFICATION SECTION 01 45 33, SPECIAL INSPECTION, OBSERVATION, AND TESTING. THESE INCLUDE:
 - A. CONTRACTOR'S REQUIREMENTS TO PROVIDE ACCESS TO THE WORK FOR REQUIRED INSPECTIONS, AND TO PROVIDE NOTICE OF REQUIRED INSPECTIONS AND STRUCTURAL OBSERVATION.
 - B. CONTRACTOR'S STATEMENT OF RESPONSIBILITY FOR WORK TO BE PERFORMED ON SYSTEMS DESIGNATED UNDER THE STATEMENT OF SPECIAL INSPECTIONS FOR WIND OR SEISMIC RESISTANCE.
 - C. DEFINITIONS AND TERMINOLOGY USED IN THIS STATEMENT OF SPECIAL INSPECTIONS.

SPECIAL INSPECTION

1. SPECIAL INSPECTION WILL BE IN ACCORDANCE WITH IBC SECTIONS 1705 TOGETHER WITH LOCAL AND STATE AMENDMENTS. REFER TO THE FOLLOWING TABLES FOR PROJECT SPECIFIC INSPECTION TYPES AND FREQUENCIES.

GRFF OZONE SYSTEM REPLACEMENT

2. SPECIAL INSPECTIONS WILL BE PROVIDED BY A CERTIFIED OR QUALIFIED INSPECTOR AND ASSOCIATED TESTING WILL BE PERFORMED BY AN APPROVED ACCREDITED INDEPENDENT AGENCY. THE OWNER WILL SECURE AND PAY FOR THE SERVICES OF THE AGENCY TO PERFORM ALL SPECIAL INSPECTION AND ASSOCIATED TESTS. INSPECTORS FOR EACH SYSTEM AND MATERIAL WILL BE INTERNATIONAL CODE COUNCIL (ICC) CERTIFIED OR OTHERWISE APPROVED BY THE BUILDING OFFICIAL.
3. THE SPECIAL INSPECTOR WILL OBSERVE THE INDICATED WORK FOR COMPLIANCE WITH THE APPROVED CONTRACT DOCUMENTS AND SUBMIT RECORDS OF INSPECTION. ALL DISCREPANCIES WILL BE BROUGHT TO THE IMMEDIATE ATTENTION OF THE CONTRACTOR FOR CORRECTION.
4. SPECIAL INSPECTION AND ASSOCIATED TESTING REPORTS WILL BE SUBMITTED TO THE ENGINEER, CONTRACTOR, BUILDING OFFICIAL, AND OWNER WITHIN ONE WEEK OF INSPECTION OR WITHIN ONE WEEK OF TEST COMPLETION. INSPECTIONS FOR WHICH REPORTING WILL BE REQUIRED ARE NOTED IN THE FOLLOWING TABLES.
5. AT THE CONCLUSION OF CONSTRUCTION, A FINAL REPORT DOCUMENTING REQUIRED SPECIAL INSPECTIONS AND CORRECTION OF PREVIOUSLY NOTED DISCREPANCIES WILL BE SUBMITTED.

Statement of Special Inspections Prepared by:

Type or Print Name

Signature

Date

Preparer's Seal

TABLE 1 REQUIRED STRUCTURAL SPECIAL INSPECTION REFER TO SPECIFICATION SECTION 01 45 33						
SYSTEM	2021 IBC CODE REFERENCE	REFERENCED STANDARD	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
CONCRETE						
1. INSPECT ANCHORS CAST IN CONCRETE	1705.3	ACI 318: 26.13.3.3	X			
2. INSPECT ANCHORS OR DOWELS POST- INSTALLED IN HARDENED CONCRETE MEMBERS						
A. ADHESIVE ANCHORS OR DOWELS INSTALLED IN HORIZONTALLY OR UPWARDLY INCLINED ORIENTATIONS TO RESIST SUSTAINED TENSION LOADS	1705.3	ACI 318: 26.13.3.2, ICC-ES EVALUATION REPORTS		X		
B. MECHANICAL ANCHORS AND ADHESIVE ANCHORS OR DOWELS NOT DEFINED IN 4A.	1705.3	ACI 318: 26.13.3.3, ICC-ES EVALUATION REPORTS	X			

GRFF OZONE SYSTEM REPLACEMENT

NOTES:

1. PERIODIC INSPECTION IS DEFINED AS INSPECTION BY THE SPECIAL INSPECTOR OF ALL MATERIALS AND SYSTEMS, IN SOME CASES PERFORMED DURING THEIR PLACEMENT AND IN ALL CASES PERFORMED UPON COMPLETION OF THEIR PLACEMENT. THE COMPLETION INSPECTION SHALL BE PERFORMED SO THAT WORK CAN BE CORRECTED PRIOR TO OTHER RELATED WORK PROCEEDING AND COVERING INSPECTED WORK.
2. VISUAL INSPECTION IS THE RESPONSIBILITY OF THE CONTRACTOR'S WELDING INSPECTOR(S) AND IS NOT CONSIDERED SPECIAL INSPECTION. CONTRACTOR MUST PROVIDE A QUALIFIED WELDING INSPECTOR TO OVERSEE CONTRACTOR'S WELDING OPERATIONS, AS REQUIRED BY SPECIFICATION SECTION 05 05 23 AND REFERENCED WELDING CODES.

TABLE 2

**REQUIRED SPECIAL INSPECTION FOR SEISMIC RESISTANCE FOR STRUCTURAL SYSTEMS
REFER TO TABLE 2 FOR STANDARD STRUCTURAL SPECIAL INSPECTION REQUIREMENTS
REFER TO SPECIFICATION SECTION 01 45 33**

The Seismic Design Category (SDC) for this Project is D.

SYSTEM	INSPECTION REQUIRED FOR FOLLOWING SEISMIC DESIGN CATEGORIES	2021 IBC CODE REFERENCE	PERIODIC OWNER FURNISHED SPECIAL INSPECTION (SEE NOTE 1)	CONTINUOUS OWNER FURNISHED SPECIAL INSPECTION	COMMENTS	TESTING FOR SPECIAL INSPECTION
ELECTRICAL						
INSTALLATION OF ANCHORAGE OF ELECTRICAL EQUIPMENT FOR EMERGENCY OR STANDBY POWER SYSTEMS	"C" AND ABOVE	1705.13.6 ITEM 1	X		NOTES 2 & 3	
INSTALLATION OF ANCHORAGE OF ALL OTHER ELECTRICAL EQUIPMENT	"E" AND ABOVE	1705.13.6 ITEM 2	X		NOTES 2 & 3	
INSTALLATION OF OTHER SEISMIC SUPPORTS FOR DESIGNATED ELECTRICAL SYSTEMS AND THEIR COMPONENTS	"B" AND ABOVE	1705.14.2	X		NOTES 2 & 3	SEE TABLE 6

GRFF OZONE SYSTEM REPLACEMENT

PROCESS MECHANICAL						
INSTALLATION OF PIPING SYSTEMS MEANT TO CARRY HAZARDOUS MATERIALS AND ITS ASSOCIATED MECHANICAL UNITS	"C" AND ABOVE	1705.13.6 ITEM 3	X			
INSTALLATION OF OTHER SEISMIC SUPPORTS FOR DESIGNATED MECHANICAL SYSTEMS AND THEIR COMPONENTS	"B" AND ABOVE	1705.14.2	X		NOTES 2 & 3	SEE TABLE 6

NOTES:

1. PERIODIC INSPECTION IS DEFINED AS INSPECTION BY THE SPECIAL INSPECTOR OF ALL MATERIALS AND SYSTEMS, IN SOME CASES PERFORMED DURING THEIR PLACEMENT AND IN ALL CASES PERFORMED UPON COMPLETION OF THEIR PLACEMENT. THE COMPLETION INSPECTION SHALL BE PERFORMED SO THAT WORK CAN BE CORRECTED PRIOR TO OTHER RELATED WORK PROCEEDING AND COVERING THE INSPECTED WORK
2. TESTING OF SYSTEMS AND THEIR ANCHORAGE SHALL BE IN CONFORMANCE WITH 2021 IBC SECTION 1705.14.2.
3. CERTIFICATION OF SYSTEMS AND THEIR ANCHORAGE SHALL BE IN CONFORMANCE WITH 2021 IBC SECTION 1705.14.3.

**SECTION 01 61 00
COMMON PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 DEFINITIONS

A. Products:

1. New items for incorporation in the Work, whether purchased by Contractor or Owner for the Project, or taken from previously purchased stock, and may also include existing materials or components required for reuse.
2. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change meaning of such other terms used in Contract Documents, as those terms are self-explanatory and have well recognized meanings in construction industry.
3. Items identified by manufacturer's product name, including make or model designation, indicated in manufacturer's published product literature, that is current as of the date of the Contract Documents.

1.02 DESIGN REQUIREMENTS

- A.** Where Contractor design is specified, design of installation, systems, equipment, and components, including supports and anchorage, shall be in accordance with provisions of 2021 International Building Code (IBC) by International Code Council and Site-specific seismic criteria, noted on the Drawings.

1.03 ENVIRONMENTAL REQUIREMENTS

- A.** Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at 900 feet above sea level.
- B.** Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of 0 degree F to 110 degrees F.

GRFF OZONE SYSTEM REPLACEMENT

1.04 PREPARATION FOR SHIPMENT

- A. When practical, factory assemble products. Mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable protective coating.
- B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project and Contractor, equipment number, and approximate weight. Include complete packing list and bill of materials with each shipment.
- C. Extra Materials, Special Tools, Test Equipment, and Expendables:
 - 1. Furnish as required by individual specifications.
 - 2. Schedule:
 - a. Ensure that shipment and delivery occurs concurrent with shipment of associated equipment.
 - b. Transfer to Owner shall occur immediately subsequent to Contractor's acceptance of equipment from Supplier.
 - 3. Packaging and Shipment:
 - a. Package and ship extra materials and special tools to avoid damage during long term storage in original cartons insofar as possible, or in appropriately sized, hinged-cover, wood, plastic, or metal box.
 - b. Prominently displayed on each package, the following:
 - 1) Manufacturer's part nomenclature and number, consistent with Operation and Maintenance Manual identification system.
 - 2) Applicable equipment description.
 - 3) Quantity of parts in package.
 - 4) Equipment manufacturer.
 - 4. Deliver materials to Site. Notify Owner upon arrival for transfer of materials.
 - 5. Replace extra materials and special tools found to be damaged or otherwise inoperable at time of transfer to Owner.
- D. Request a minimum 7-day advance notice of shipment from manufacturer.
 - 1. Confirm acceptable delivery days and hours with Owner.
- E. Factory Test Results: Reviewed and accepted by Engineer before product is prepared for shipment as required in individual specification sections.

1.05 DELIVERY AND INSPECTION

- A. Deliver products in accordance with accepted current Progress Schedule and coordinate to avoid conflict with the Work and conditions at Site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.
- B. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable.
- C. Unload products in accordance with manufacturer's instructions for unloading or as specified. Record receipt of products at Site. Promptly inspect for completeness and evidence of damage during shipment.
 - 1. Contractor responsible for unloading equipment detailed in Section 01 64 00, Owner-Furnished Products.
- D. Remove damaged products from Site and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

1.06 HANDLING, STORAGE, AND PROTECTION

- A. Handle and store products in accordance with manufacturer's written instructions and in a manner to prevent damage. Store in approved storage yards or sheds provided by Contractor, there is no available storage inside ozone buildings. Provide manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by Owner.
- B. Manufacturer's instructions for material requiring special handling, storage, or protection shall be provided prior to delivery of material.
- C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to ensure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered, but not installed in the Work.
- D. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60 degrees F and below 70 percent relative humidity. Contractor to provide weekly testing by the contractor to check that storage sheds meet temperature and humidity requirements. Protect electrical, instrumentation, and control products, and insulate against moisture, water, and dust damage. Connect and operate continuously space heaters furnished in electrical equipment.

GRFF OZONE SYSTEM REPLACEMENT

- E. Store fabricated products above ground on blocking or skids, and prevent soiling or staining. Store loose granular materials in well-drained area on solid surface to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.
- F. Store finished products that are ready for installation in dry and well-ventilated areas. Do not subject to extreme changes in temperature or humidity.
- G. After installation, provide coverings to protect products from damage due to traffic and construction operations. Remove coverings when no longer needed.
- H. Hazardous Materials: Prevent contamination of personnel, storage area, and Site. Meet requirements of product specification, codes, and manufacturer's instructions.
 - 1. Any Hazardous material shall be identified by a Safety Data Sheet, available on site and spill response kits to be provided by the Contractor.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide manufacturer's standard materials suitable for service conditions, unless otherwise specified in the individual specifications.
- B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.
- C. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.
- D. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents or as approved by Engineer.
- E. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified or approved by Engineer.

- F. Equipment, Components, Systems, and Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.
- G. Regulatory Requirement: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.
- H. Safety Guards: Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal. Use 16-gauge or heavier; galvanized steel, aluminum coated steel, or galvanized or aluminum coated 1/2-inch mesh expanded steel. Provide galvanized steel accessories and supports, including bolts. For outdoors application, prevent entrance of rain and dripping water.
- I. Authority Having Jurisdiction (AHJ):
 - 1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.
- J. Equipment Finish:
 - 1. Provide manufacturer's standard finish and color, except where specific color is indicated.
 - 2. If manufacturer has no standard color, provide equipment with gray finish as approved by Owner.
- K. Special Tools and Accessories: Furnish to Owner, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other spare parts as required for maintenance.
- L. Lubricant: Provide initial lubricant recommended by equipment manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by Owner.

GRFF OZONE SYSTEM REPLACEMENT

M. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with NSF/ANSI 61 and the maximum lead content standard in accordance with NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 FABRICATION AND MANUFACTURE

A. General:

1. Manufacture parts to U.S.A. standard sizes, English units, and gauges.
2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
3. Design structural members for anticipated shock and vibratory loads.
4. Use 1/4-inch minimum thickness for steel that will be submerged, wholly or partially, during normal operation.
5. Modify standard products as necessary to meet performance specifications.

B. Lubrication System:

1. Require no more than weekly attention during continuous operation.
2. Convenient and accessible; oil drains with bronze or stainless steel valves and fill-plugs easily accessible from the normal operating area or platform. Locate drains to allow convenient collection of oil during oil changes without removing equipment from its installed position.
3. Provide constant-level oilers or oil level indicators for oil lubrication systems.
4. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

2.03 SOURCE QUALITY CONTROL

A. Where these Specifications call for factory testing to be witnessed by Engineer, notify Engineer not less than 14 days prior to scheduled test date, unless otherwise specified.

- B. Calibration Instruments: Bear the seal of a reputable laboratory certifying instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).
- C. Factory Tests: Perform in accordance with accepted test procedures and document successful completion.

PART 3 EXECUTION

3.01 INSPECTION

- A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing such effects. Remove damaged material or equipment from the Site and expedite delivery of identical new material or equipment. Delays to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays within Contractor's control.

3.02 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

- A. When so specified, a Manufacturer's Certificate of Compliance, a copy of which is attached to this section, shall be completed in full, signed by entity supplying the product, material, or service, and submitted prior to shipment of product or material or execution of the services.
- B. Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.
- C. Such form shall certify proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.
- D. May reflect recent or previous test results on material or product, if acceptable to Engineer.

3.03 INSTALLATION

- A. Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.
- B. No shimming between machined surfaces is allowed.
- C. Install the Work in accordance with NECA Standard of Installation, unless otherwise specified.
- D. Repaint painted surfaces that are damaged prior to equipment acceptance.

GRFF OZONE SYSTEM REPLACEMENT

- E. Do not cut or notch any structural member or building surface without specific approval of Engineer.
- F. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's instructions, and as may be specified. Retain a copy of manufacturers' instruction at Site, available for review at all times.
- G. For material and equipment specifically indicated or specified to be reused in the Work:
 - 1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
 - 2. Arrange for transportation, storage, and handling of products that require offsite storage, restoration, or renovation. Include costs for such Work in the Contract Price.

3.04 EQUIPMENT LABELS

- A. Type 316 stainless steel equipment labels, 22-gauge minimum thickness for all equipment.
 - 1. Applies to equipment with assigned tag numbers, where specified.
 - 2. Letters: Black or white, as approved, to best contrast with the color of the equipment, 2 inches high. Text to be in ALL CAPS and printed in a single line.
 - 3. Message: Equipment names and tag numbers as used in sections where equipment is specified.

3.05 FIELD FINISHING

- A. In accordance with Suppliers Instructions, and individual specification sections.

3.06 ADJUSTMENT AND CLEANING

- A. Perform required adjustments, tests, operation checks, and other startup activities.

3.07 LUBRICANTS

- A. Fill lubricant reservoirs and replace consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

3.08 SUPPLEMENT

A. The supplement listed below, following “End of Section,” is a part of this specification:

1. Manufacturer’s Certificate of Compliance.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER: _____ PRODUCT, MATERIAL, OR SERVICE
PROJECT NAME: _____ SUBMITTED: _____
PROJECT NO: _____

Comments: _____

I hereby certify that the above-referenced product, material, or service called for by the Contract for the named Project will be furnished in accordance with all applicable requirements. I further certify that the product, material, or service are of the quality specified and conform in all respects with the Contract requirements, and are in the quantity shown.

Date of Execution: _____, 20____

Manufacturer: _____

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

(Authorized Signature)

SECTION 01 64 00
OWNER-FURNISHED PRODUCTS

PART 1 GENERAL

1.01 DEFINITIONS

- A. Contractor: Ozone equipment package installing Contractor.
- B. Owner: Tacoma Water, owner and operator of Green River Filtration Facility.
- C. Ozone Equipment Package: Equipment provided by the Ozone System Supplier as part of the Ozone Equipment Procurement Contract.
- D. Ozone Equipment Procurement Contract: The Contract signed between Owner and Supplier and attached for reference.
- E. Supplier or Manufacturer or Ozone System Supplier (OSS): The party under separate contract with Owner to furnish the products or special services specified herein.

1.02 OWNER-FURNISHED PRODUCTS

- A. Ozone Equipment Package:
 - 1. Ozone System Supplier (OSS) Primary Contact:
 - a. Luis Cardenas, Project Manager.
 - b. VEOLIA Water Technologies & Solutions.
 - c. 600 Willow Tree Road, Leonia, NJ 07605.
 - d. Telephone: +1-973-219-8832.
 - e. Mobile: +1-973-432-4979.
 - f. Email: luis.cardenas1@veolia.com.
 - 2. Point of Receipt: Project Site.
 - 3. Estimated Date of Arrival: No later than the dates outlined in Section 01 31 13, Project Coordination, Article Project Milestones.
 - 4. Equipment or Facility Necessary for Receipt and Unloading of Product: Coordinate with Owner and Supplier.
 - 5. Estimated Weight of Product: Coordinate with Supplier.
 - 6. Special Handling or Storage Instructions: Coordinate with Supplier.
 - 7. Associated special services to be provided by OSS as described in the Ozone Equipment Procurement Contract:
 - a. Installation assistance.
 - b. Certification of proper installation.
 - c. Functional testing assistance.

GRFF OZONE SYSTEM REPLACEMENT

- d. Performance testing assistance.
- e. Training of Owner's personnel.

1.03 INFORMATION FURNISHED BY OWNER

- A. OSS's equipment package proposal is attached to the Contract Documents as Part 3, Veolia Power Supply Unit Procurement Proposal and Control Panel Procurement Proposal.
- B. Shop Drawings available at the time of bidding will be made available for Contractor's use in performing the Work under this section, in Part 3.
- C. Manufacturer's installation, operation, and maintenance instructions for Owner-furnished products will be made available.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - 2. Show layout, location, and identification of materials provided by Contractor for installation of Owner-furnished products.
 - a. Include pipe, fittings, valves, specialties, hangers, supports, equipment, and required specialties.
 - b. Provide electrical and instrumentation diagrams to indicate connecting and interconnecting electrical and control work.
 - c. Submit complete list of materials to be furnished, and include data necessary to allow Owner to determine their fitness for the Work.

1.05 TRANSFER OF PRODUCTS

- A. Unless indicated otherwise, items will be furnished f.o.b. the Project Site.
- B. Upon delivery, conduct with Owner or Engineer a joint inspection for the purpose of identifying product, general verification of quantities, and observation of apparent condition. Such inspection will not be construed as final or as receipt of any product that, as a result of subsequent inspections and tests, are determined to be nonconforming.
- C. Damaged or incomplete products to be returned for replacement will not be unloaded, except as necessary to expedite return shipment. Contractor shall collaborate with Owner to submit claims for transportation damage and expedite replacement of damaged, defective, or deficient items.
- D. Indicate signed acceptance of delivery on a copy of the invoice.

- E. If Contractor is not prepared to accept delivery of Owner-furnished products by either the specified Estimated Date of Arrival or such Owner-confirmed delivery date, as specified herein, associated costs incurred by Owner shall be borne by Contractor. Such costs may include, but not be limited to, demurrage, interest, insurance costs, additional administrative and engineering costs, additional factory and field technical support, additional storage and reshipping costs, cost escalation, and extended warranty costs due.

1.06 UNLOADING, STORAGE AND MAINTENANCE

- A. Subsequent to transfer, Contractor shall have complete responsibility for unloading Owner-furnished products. Unload product in accordance with manufacturers' instructions, or as specified.
- B. Store, protect, and maintain product to prevent damage until final acceptance of completed work, in accordance with Section 01 64 00, Owner-Furnished Products. Damage to or loss of products after date of transfer to Contractor shall be repaired to original condition, or replaced with new identical products, at the discretion of Engineer.
- C. Maintain complete inventory of all Owner-furnished products after their transfer to Contractor.

1.07 SCHEDULING AND SEQUENCING

- A. Include sequencing constraints specified herein as part of Progress Schedule.
- B. Owner will keep Contractor informed of probable delivery date changes.
- C. Owner will confirm estimated delivery date with Contractor 10 days prior to scheduled delivery, and within 48 hours of expected delivery time.
- D. Where a preinstallation meeting is required by this section, provide a minimum of 10 days' advance written notice to Owner of the proposed date for starting installation.
- E. Provide a minimum of 10 days notice to Owner that Owner-furnished product is ready for all special services listed herein to be furnished by Owner through its contract with seller. Contractor shall bear the cost of all damages assessed to Owner by seller resulting from delays caused by Contractor.

GRFF OZONE SYSTEM REPLACEMENT

1.08 EXTRA MATERIALS

- A. Unless otherwise specified, Owner will take acceptance of, and be responsible for storing associated extra materials and special tools upon delivery.

1.09 PREINSTALLATION MEETING

- A. Arrange and attend a preinstallation meeting with the Engineer, Owner, and Supplier to review general procedures, erection and installation instructions, and installation sequence.
- B. Additional meetings prior to installation may be required, as determined by Owner, to transmit Owner's installation instructions to Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in conformance with Owner-furnished product Shop Drawings and installation instructions.
- B. Provide all interconnecting supports, structures, equipment, valves, piping, electrical and instrumentation work, finish painting, and appurtenances not included in the Ozone Equipment Procurement Contract to achieve a complete and functional system.
- C. Provide foundation pads for Owner-furnished products as shown. Verify exact dimensions and configuration of all pads, including penetrations, with Owner-furnished product Shop Drawings.
- D. Anchor Bolts:
 - 1. Where required, provide anchor bolts, fasteners, washers, and templates needed for installation of Owner-furnished equipment.
 - 2. Size and locate anchor bolts in accordance with Owner-furnished product Shop Drawings and installation instructions.
- E. Mechanical and electrical equipment shall be properly aligned, plumb and level, with no stresses on connecting piping or conduit.
- F. Verify direction of motor rotation before starting equipment.
- G. Verify operability and safety of electrical system needed to operate equipment. Check electrical system for continuity, phasing, grounding, and proper functions.

- H. Apply arc flash labels as approved by Engineer.
- I. Pump Installation:
 - 1. Level base by means of steel wedges (steel plates and steel shims). Wedge taper not greater than 1/4-inch per foot. Use double wedges to provide level bearing surface for the pump and driver base. Accomplish wedging so there is no change of level or springing of baseplate when anchor bolts are tightened.
 - 2. Adjust pump assemblies so driving units are properly aligned, plumb, and level with driven units and all interconnecting shafts and couplings. Do not compensate for misalignment by use of flexible couplings.
 - 3. After pump and driver have been set in position, aligned, and shimmed to proper elevation, grout space between bottom of baseplate and concrete foundation with a poured, nonshrinking grout. Remove wedges after grout is set and pack void with grout.
 - 4. Connect suction and discharge piping without imposing strain to pump flanges. Pump discharge and suction flexible couplings or bellows shall not be considered to compensate for misalignment.
 - 5. Pipe pump drain(s) to hub drain or scupper.
- J. Valves and Electric Valve Actuators:
 - 1. Install per manufacturer's recommendations.
 - 2. Set, verify, and record set pressures for relief and regulating valves.
 - 3. Automatic valves to be tested in conjunction with control system testing. Set opening and closing speeds, limit switches, as required or recommended by Supplier and Engineer.
 - 4. Test that valves open and close smoothly under operating pressure conditions. Test that two-way valves open and close smoothly under operating pressure conditions from both directions.
- K. Instruments and Control Panels: Refer to Section 40 90 00, Instrumentation and Control for Process Systems, for installation details.
- L. Sidestream Pump Motor Starters:
 - 1. General:
 - a. Install equipment in accordance with NEMA ICS 2.3, IEEE C2, NECA 402, Submittals, and manufacturer's written instructions and recommendations.
 - b. Secure equipment to mounting pads with anchor bolts of sufficient size and number adequate for specified seismic conditions.
 - c. Install equipment plumb and in longitudinal alignment with pad or wall.

GRFF OZONE SYSTEM REPLACEMENT

- d. Coordinate terminal connections with installation of secondary feeders.
- e. Grout mounting channels into floor or mounting pads.
- f. Retighten current-carrying bolted connections and enclosure support framing and panels to manufacturer's recommendations.
- g. Motor Data:
 - 1) Provide typed, self-adhesive label attached inside each motor starter enclosure door displaying the following information:
 - a) Motor served by tag number and equipment name.
 - b) Nameplate horsepower.
 - c) Motor code letter.
 - d) Full load amperes.
 - e) Service factor.
 - f) Installed overload relay catalog number.
 - 2. Circuit Breakers:
 - a. Field adjust trip settings of motor starter magnetic-trip-only circuit breakers.
 - b. Adjust per the protection coordination study.
 - c. Determine motor rated current from motor nameplate following installation.

3.02 FIELD FINISHING

- A. Products will be delivered with prime and finish coat(s) applied.
 - 1. Touch up or repair damage to coatings resulting from unloading, storage, installation, testing, and startup.
 - 2. Touch up or repair damage to existing owner coatings resulting from unloading, storage, installation, testing, and startup.
 - 3. If finish coats are damaged extensively after transfer, completely repaint.
 - 4. Touch up, repair, or complete repainting shall match color of original paint, and shall be fully compatible with applied primers and finish.

3.03 PRODUCT PROTECTION

- A. Immediately after installation, lubricate components in accordance with manufacturer's instructions.
- B. Follow manufacturer's instructions for protection and maintenance during storage, after installation but prior to testing and startup, and after startup but prior to acceptance.

- C. Furnish incidental supplies including lubricants, cleaning fluids, and similar products as needed for protecting and maintaining the Owner-furnished products.

3.04 TESTS AND INSPECTION

- A. Perform tests and inspections of installed products in accordance with requirements shown herein, Section 01 91 14, Equipment Testing and Facility Startup, and manufacturer's instructions.
- B. Coordinate with Supplier for tests and inspections as described in Section 01 31 13, Project Coordination.

END OF SECTION

**SECTION 01 77 00
CLOSEOUT PROCEDURES**

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Submit prior to application for final payment.
 - a. Record Documents: As required in General Conditions.
 - b. Special bonds, Special Guarantees, and Service Agreements.
 - c. Consent of Surety to Final Payment: As required in General Conditions.
 - d. Releases or Waivers of Liens and Claims: As required in General Conditions.
 - e. Releases from Agreements.
 - f. Final Application for Payment: Submit in accordance with procedures and requirements stated in Section 01 29 00, Payment Procedures.
 - g. Extra Materials: As required by individual specification sections.

1.02 RECORD DOCUMENTS

A. Quality Assurance:

1. Furnish qualified and experienced person, whose duty and responsibility shall be to maintain record documents.
2. Accuracy of Records:
 - a. Coordinate changes within record documents, making legible and accurate entries on each sheet of the Drawings and other documents where such entry is required to show change.
 - b. Purpose of Project record documents is to document factual information regarding aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive Site measurement, investigation, and examination.
3. Make entries within 24 hours after receipt of information that a change in the Work has occurred.
4. Prior to submitting each request for progress payment, request Engineer's review and approval of current status of record documents. Failure to properly maintain, update, and submit record documents may result in a deferral by Engineer to recommend whole or any part of Contractor's Application for Payment, either partial or final.

GRFF OZONE SYSTEM REPLACEMENT

1.03 RELEASES FROM AGREEMENTS

- A. Furnish Owner written releases from property owners or public agencies where side agreements or special easements have been made, or where Contractor's operations have not been kept within the Owner's construction right-of-way.
- B. In the event Contractor is unable to secure written releases:
 - 1. Inform Owner of the reasons.
 - 2. Owner or its representatives will examine the Site, and Owner will direct Contractor to complete the Work that may be necessary to satisfy terms of the side agreement or special easement.
 - 3. Should Contractor refuse to perform this Work, Owner reserves right to have it done by separate contract and deduct cost of same from Contract Price, or require Contractor to furnish a satisfactory bond in a sum to cover legal Claims for damages.
 - 4. When Owner is satisfied that the Work has been completed in agreement with Contract Documents and terms of side agreement or special easement, right is reserved to waive requirement for written release if: (i) Contractor's failure to obtain such statement is due to grantor's refusal to sign, and this refusal is not based upon any legitimate Claims that Contractor has failed to fulfill terms of side agreement or special easement, or (ii) Contractor is unable to contact or has had undue hardship in contacting grantor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS

- A. General:
 - 1. Promptly following commencement of Contract Times, secure from Engineer at no cost to Contractor, one complete set of Contract Documents.
 - 2. Label or stamp each record document with title, "RECORD DOCUMENTS," in neat large printed letters.
 - 3. Record information concurrently with construction progress and within 24 hours after receipt of information that change has occurred. Do not cover or conceal Work until required information is recorded.

B. Preservation:

1. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
2. Make documents and Samples available at all times for observation by Engineer.

C. Making Entries on the Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
 - a. Color Coding:
 - 1) Green when showing information deleted from the Drawings.
 - 2) Red when showing information added to the Drawings.
 - 3) Blue and circled in blue to show notes.
2. Date entries.
3. Call attention to entry by “cloud” drawn around area or areas affected.
4. Legibly mark to record actual changes made during construction, including, but not limited to:
 - a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
 - b. Horizontal and vertical locations of existing and new Underground Facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements to permanent surface improvements.
 - c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
 - d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
 - e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, and Engineer’s written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.
5. Dimensions on Schematic Layouts: Show on the Record Drawings, by dimension, the centerline of each run of items such as are described in previous subparagraph above.
 - a. Clearly identify the item by accurate note such as “cast iron drain,” “galv. water,” and the like.

GRFF OZONE SYSTEM REPLACEMENT

- b. Show, by symbol or note, vertical location of item (“under slab,” “in ceiling plenum,” “exposed,” and the like).
- c. Make identification so descriptive that it may be related reliably to these specifications.

3.02 FINAL CLEANING

- A. At completion of the Work or of a part thereof and immediately prior to Contractor’s request for certificate of Substantial Completion; or if no certificate is issued, immediately prior to Contractor’s notice of completion, clean entire Site or parts thereof, as applicable.
 - 1. Leave the Work and adjacent areas affected in a cleaned condition satisfactory to Owner.
 - 2. Remove grease, dirt, dust, paint or plaster splatter, stains, labels, fingerprints, and other foreign materials from exposed surfaces.
 - 3. Repair, patch, and touch up marred surfaces to specified finish and match adjacent surfaces.
 - 4. Broom clean exterior paved driveways and parking areas.
 - 5. Hose clean sidewalks, loading areas, and others contiguous with principal structures.
 - 6. Rake clean all other surfaces.
 - 7. Remove snow and ice from access to buildings.
 - 8. Replace air-handling filters and clean ducts, blowers, and coils of ventilation units operated during construction.
 - 9. Leave water courses, gutters, and ditches open and clean.
- B. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Detailed information for the preparation, submission, and Engineer's review of Operations and Maintenance (O&M) Data, as required by individual specification sections.

1.02 DEFINITIONS

- A. Final Data: Engineer-accepted data, submitted as specified herein.
- B. Electrical Maintenance: Required maintenance and operation per NFPA 70B and NFPA 70E.
- C. Maintenance Operation: As used on Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations are lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.
- D. Preliminary Data: Initial and subsequent submissions for Engineer's review.

1.03 SEQUENCING AND SCHEDULING

- A. Equipment and System Data:
 - 1. Preliminary Data:
 - a. Do not submit until Shop Drawing for equipment or system has been reviewed and approved by Engineer.
 - b. Submit prior to shipment date.
 - 2. Final Data: Submit Compilation Formatted and Electronic Media Formatted data prior to Substantial Completion of Project.
- B. Materials and Finishes Data:
 - 1. Preliminary Data: Submit at least 15 days prior to request for final inspection.
 - 2. Final Data: Submit within 10 days after final inspection.

GRFF OZONE SYSTEM REPLACEMENT

1.04 DATA FORMAT

- A. Prepare preliminary and final data in the form of an instructional manual. Prepare final data on electronic media.
- B. Instructional Manual Format:
 - 1. Binder: Commercial quality, permanent, three-ring or three-post binders with durable plastic cover.
 - 2. Size: 8-1/2 inches by 11 inches, minimum.
 - 3. Cover: Identify manual with typed or printed title "OPERATION AND MAINTENANCE DATA" and list:
 - a. Project title.
 - b. Designate applicable system, equipment, material, or finish.
 - c. Identity of separate structure as applicable.
 - d. Identify volume number if more than one volume.
 - e. Identity of equipment number and specification section.
 - 4. Spine:
 - a. Project title.
 - b. Identify volume number if more than one volume.
 - 5. Title Page:
 - a. Contractor name, address, and telephone number.
 - b. Subcontractor, Supplier, installer, or maintenance contractor's name, address, and telephone number, as appropriate.
 - 1) Identify area of responsibility of each.
 - 2) Provide name and telephone number of local source of supply for parts and replacement.
 - 6. Table of Contents:
 - a. Neatly typewritten and arranged in systematic order with consecutive page numbers.
 - b. Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.
 - 7. Paper: 20-pound minimum, white for typed pages.
 - 8. Text: Manufacturer's printed data, or neatly typewritten.
 - 9. Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.
 - 10. Material shall be suitable for reproduction, with quality equal to original. Photocopying of material will be acceptable, except for material containing photographs.

C. Electronic Media Format:

1. Portable Document Format (PDF):
 - a. After all preliminary data has been found to be acceptable to Engineer, submit Operation and Maintenance data in PDF format.
 - b. Files to be exact duplicates of Engineer-accepted preliminary data. Arrange by specification number and name.
 - c. Files to be fully functional and viewable in most recent version of Adobe Acrobat.
 - d. Provide bookmarks for all items identified in the Table of Contents with nesting matching table of contents.

1.05 SUBMITTALS

A. Informational:

1. Preliminary Data: Submit for Engineer's review in PDF format.
2. Final Data: Submit to Owner in electronic format (PDF) on a single USB flashdrive and three hardcopy format.

1.06 DATA FOR EQUIPMENT AND SYSTEMS

A. Content For Each Unit (or Common Units) and System:

1. Product Data:
 - a. Include only those sheets that are pertinent to specific product.
 - b. Clearly annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information.
 - c. Function, normal operating characteristics, and limiting conditions.
 - d. Performance curves, engineering data, nameplate data, and tests.
 - e. Complete nomenclature and commercial number of replaceable parts.
 - f. Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
 - g. Spare parts ordering instructions.
 - h. Where applicable, identify installed spares and other provisions for future work (such as: reserved panel space, unused components, wiring, terminals).
2. As-installed, color-coded piping diagrams.
3. Charts of valve tag numbers, with the location and function of each valve.

GRFF OZONE SYSTEM REPLACEMENT

4. Drawings:
 - a. Supplement product data with Drawings as necessary to clearly illustrate:
 - 1) Format:
 - a) Provide reinforced, punched, binder tab; bind in with text.
 - b) Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.
 - c) Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.
 - d) Identify specification section and product on the Drawings and envelopes.
 - 2) Relations of component parts of equipment and systems.
 - 3) Control and flow diagrams.
 - 4) Coordinate drawings with Project record documents to assure correct illustration of completed installation.
5. Instructions and Procedures: Within text, as required to supplement product data.
 - a. Format:
 - 1) Organize in consistent format under separate heading for each different procedure.
 - 2) Provide logical sequence of instructions for each procedure.
 - 3) Provide information sheet for Owner's personnel, including:
 - a) Proper procedures in event of failure.
 - b) Instances that might affect validity of guarantee or Bond.
 - b. Installation Instructions: Including alignment, adjusting, calibrating, and checking.
 - c. Operating Procedures:
 - 1) Startup, break-in, routine, and normal operating instructions.
 - 2) Test procedures and results of factory tests where required.
 - 3) Regulation, control, stopping, and emergency instructions.
 - 4) Description of operation sequence by control manufacturer.
 - 5) Shutdown instructions for both short and extended duration.
 - 6) Summer and winter operating instructions, as applicable.
 - 7) Safety precautions.
 - 8) Special operating instructions.
 - d. Maintenance and Overhaul Procedures:
 - 1) Routine maintenance.
 - 2) Guide to troubleshooting.
 - 3) Disassembly, removal, repair, reinstallation, and re-assembly.
6. Guarantee, Bond, and Service Agreement: In accordance with Section 01 77 00, Closeout Procedures.

B. Content for Each Electric or Electronic Item or System:

1. Description of Unit and Component Parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data, nameplate data, and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
 - d. Interconnection wiring diagrams, including control and lighting systems.
2. Circuit Directories of Panelboards.
3. Electrical service.
4. Control requirements and interfaces.
5. Communication requirements and interfaces.
6. List of electrical relay settings, and control and alarm contact settings.
7. Electrical interconnection wiring diagram, including as applicable, single-line, three-line, schematic and internal wiring, and external interconnection wiring.
8. As-installed control diagrams by control manufacturer.
9. Operating Procedures:
 - a. Routine and normal operating instructions.
 - b. Startup and shutdown sequences, normal and emergency.
 - c. Safety precautions.
 - d. Special operating instructions.
10. Maintenance Procedures:
 - a. Electrical maintenance.
 - b. Routine maintenance.
 - c. Guide to troubleshooting.
 - d. Adjustment and checking.
 - e. List of relay settings, control and alarm contact settings.
11. Manufacturer's printed operating and maintenance instructions.
12. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

C. Maintenance Summary:

1. Compile individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or sub-units.
2. Format:
 - a. Use Maintenance Summary Form bound with this section or electronic facsimile of such.
 - b. Each Maintenance Summary may take as many pages as required.
 - c. Use only 8-1/2-inch by 11-inch size paper.
 - d. Complete using electronic printing.

GRFF OZONE SYSTEM REPLACEMENT

3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
4. Recommended Spare Parts:
 - a. Data to be consistent with manufacturer's Bill of Materials/Parts List furnished in O&M manuals.
 - b. "Unit" is the unit of measure for ordering the part.
 - c. "Quantity" is the number of units recommended.
 - d. "Unit Cost" is the current purchase price.

1.07 DATA FOR MATERIALS AND FINISHES

A. Content for Architectural Products, Applied Materials, and Finishes:

1. Manufacturer's data, giving full information on products:
 - a. Catalog number, size, and composition.
 - b. Color and texture designations.
 - c. Information required for reordering special-manufactured products.
2. Instructions for Care and Maintenance:
 - a. Manufacturer's recommendation for types of cleaning agents and methods.
 - b. Cautions against cleaning agents and methods that are detrimental to product.
 - c. Recommended schedule for cleaning and maintenance.

B. Content for Moisture Protection and Weather Exposed Products:

1. Manufacturer's data, giving full information on products:
 - a. Applicable standards.
 - b. Chemical composition.
 - c. Details of installation.
2. Instructions for inspection, maintenance, and repair.

1.08 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this specification:

1. Maintenance Summary Form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

MAINTENANCE SUMMARY FORM

PROJECT: _____ CONTRACT NO.: _____

1. EQUIPMENT ITEM _____

2. MANUFACTURER _____

3. EQUIPMENT/TAG NUMBER(S) _____

4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) _____

5. NAMEPLATE DATA (hp, voltage, speed, etc.) _____

6. MANUFACTURER'S LOCAL REPRESENTATIVE _____

a. Name _____ Telephone No. _____

b. Address _____

7. MAINTENANCE REQUIREMENTS

Maintenance Operation Comments	Frequency	Lubricant (If Applicable)
List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable. (Reference to manufacturer's catalog or sales literature is not acceptable.)	List required frequency of each maintenance operation.	Refer by symbol to lubricant required.

GRFF OZONE SYSTEM REPLACEMENT

8. LUBRICANT LIST

Reference Symbol	Shell	Exxon Mobile	Chevron Texaco	BP Amoco	Or Equal
List symbols used in No. 7 above.	List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.				

9. RECOMMENDED SPARE PARTS FOR OWNER'S INVENTORY.

Part No.	Description	Unit	Quantity	Unit Cost
Note: Identify parts provided by this Contract with two asterisks.				

SECTION 01 88 15
ANCHORAGE AND BRACING

PART 1 GENERAL

1.01 SUMMARY

- A. This section covers requirements for anchorage and bracing of equipment, distribution systems, and other nonstructural components required in accordance with the ICC 2021 International Building Code (IBC), for seismic, wind, gravity, soil, and operational loads.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. 2021 Washington State Building Code.
 - 2. American Institute of Steel Construction (AISC) 360, Specification for Structural Steel Buildings.
 - 3. American Society of Civil Engineers (ASCE): ASCE 7, Minimum Design Loads for Buildings and Other Structures.
 - 4. International Code Council (ICC): International Building Code (IBC).

1.03 DEFINITIONS

- A. Authority Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.
- B. Component Importance Factor:
 - 1. I_p equals 1.0, unless noted otherwise.
 - 2. I_p shall be taken as 1.5 if any of the following conditions apply:
 - a. Component is required to function for life-safety purposes after an earthquake, including fire protection systems and egress stairways.
 - b. Component conveys, supports, or otherwise contains toxic, highly toxic, or explosive substances where the quantity of the material exceeds a threshold quantity established by the Authority Having Jurisdiction and is sufficient to pose a threat to the public if released.

GRFF OZONE SYSTEM REPLACEMENT

- C. Designated Seismic System: Architectural, electrical, and mechanical system or their components for which component importance factor is greater than 1.0.

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. General:

1. Anchorage and bracing systems shall be designed by a qualified professional engineer registered in the State of Washington.
2. Design anchorage into concrete including embedment in accordance with ACI 318-19 Chapter 17 (or other industry standard approved by Engineer), and these Specifications.
 - a. Unless otherwise noted, design for cracked concrete condition.
3. Design anchorage and bracing of architectural, mechanical, and electrical components and systems in accordance with this section, unless a design is specifically provided within Contract Documents or where exempted hereinafter.
4. Design attachments, braces, and anchors for equipment, components, and distribution systems to structure for gravity, seismic, wind, and operational loading.
5. Design anchorage and bracing for modified existing architectural, mechanical, or electrical systems where code requirements would dictate design for similar new components.
6. Anchor and brace piping and ductwork, whether exempt or not exempt for this section, so that lateral or vertical displacement does not result in damage or failure to essential architectural, mechanical, or electrical equipment.
7. Architectural Components: Includes, but are not limited to, nonstructural walls and elements, partitions, cladding and veneer, access flooring, signs, cabinets, suspended ceilings, and glass in glazed curtain walls and partitions.
8. Distribution Systems: Includes, but are not limited to, piping, conduit, cable trays, and ductwork.
9. Provide supplementary framing where required to transfer anchorage and bracing loads to structure.
10. Adjust equipment pad sizes or provide additional anchorage confinement reinforcing to provide required anchorage capacities.
11. Anchor existing equipment as noted on the Drawings.
12. Design anchorage and bracing for all equipment and components for seismic loads except those exempted below. Include others loads as applicable in the design load combinations:
 - a. Furniture, excluding storage cabinets.
 - b. Temporary components that remain in place for 180 days or less.

- c. Mobile units and equipment including components that are moved from one point in the structure to another during ordinary use.
- d. Mechanical and electrical components positively attached to the structure, provided that either:
 - 1) For discrete mechanical and electrical components, the component weights 400 pounds or less, the center of mass is located 4 feet or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping, and conduit, and the Component Importance Factor, I_p , is equal to 1.0.
 - 2) For discrete mechanical and electrical components, the component weighs 20 pounds or less.
 - 3) For distribution systems, the Component Importance Factor, I_p , is equal to 1.0 and the operating weight of the system is 5 pounds per foot or less.
- 13. For components exempted from design requirements of this section, provide bolted, welded, or otherwise positively fastened attachments to supporting structure.

B. Design Loads:

- 1. Gravity: Design anchorage and bracing for self-weight and superimposed loads on components and equipment.
- 2. Wind: Design anchorage and bracing for wind criteria provided on General Structural Notes as shown on the Drawings for exposed architectural components and exterior and wind-exposed mechanical and electrical equipment. Alternately, manufacturer certification may be provided for components such as roofing and flashing to verify attachments meet Project-specific design criteria.
- 3. Operational:
 - a. For loading supplied by equipment manufacturer for IBC required load cases.
 - b. Loads may include equipment vibration, torque, thermal effects, effects of internal contents (weight and sloshing), water hammer, and other load-inducing conditions.
 - c. Locate braces to minimize vibration to or movement of structure.
 - d. For vibrating loads, use anchors meeting requirements of Section 05 05 19, Anchor Bolts, for anchors with designated capacities for vibratory loading per manufacturer's ICC ES report.
- 4. Seismic:
 - a. In accordance with 2021 IBC, Section 1613, and Chapter 13 of ASCE 7.
 - b. Design anchorage and bracing for design criteria listed on General Structural Notes as shown on the Drawings.

GRFF OZONE SYSTEM REPLACEMENT

- c. Design forces for anchors in concrete or masonry shall be in accordance with ASCE 7, Section 13.4.2 or IBC Section 1905.1.8 as applicable for Project Seismic Design Category.

C. Seismic Design Requirements:

1. Analyze local region of body of nonstructural component for load transfer of anchorage attachment if component I_p equals 1.5.
2. Fire protection sprinkler systems designed and constructed in accordance with NFPA 13 shall be considered to meet requirements of ASCE 7.
3. Provide support drawings and calculations for electrical distribution components.
4. Existing components, systems, and equipment in their final condition that are modified by Project requirements and are not exempted by above paragraph require the same anchorage and bracing drawing and calculation submittals as new equipment. Field verify existing conditions.
5. Other seismic design and detailing information identified in ASCE 7, Chapter 13, is required to be provided for new and modified or noted architectural, mechanical and electrical components, systems, or equipment.

1.05 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. List of architectural, mechanical, and electrical equipment requiring Contractor-designed anchorage and bracing, unless specifically exempted.
 - b. Manufacturers' engineered seismic and non-seismic hardware product data.
 - c. Attachment assemblies' drawings including seismic attachments; include connection hardware, braces, and anchors or anchor bolts for nonexempt components, equipment, and systems.
 - d. List of existing architectural, mechanical, and electrical equipment or components to be modified in Project requiring Contractor-designed anchorage and bracing in final retrofitted condition.
 - e. Drawings for attachment assemblies include connection hardware, braces, and anchors (or anchor bolts) for modified, nonexempt existing components, equipment, and systems where a combination of new and existing systems or components' final condition would require anchorage or bracing under this specification for new equipment.

- f. Submittal will be rejected if proposed anchorage method would create excessive stress to supporting member. Revise anchorages and strengthen structural support to eliminate overstressed condition.

B. Informational Submittals:

- 1. Anchorage and Bracing Calculations: For attachments, braces, and anchorages, include IBC and Project-specific criteria as noted on General Structural Notes as shown on the Drawings, in addition to manufacturer's specific criteria used for design; sealed by a civil or structural engineer registered in the State of Washington.
- 2. Manufacturer's hardware installation requirements.

C. Deferred Submittals:

- 1. Submitted anchorage drawings and calculations are identified as IBC deferred submittals and will be submitted to and must be accepted by AHJ prior to installation of component, equipment, or distribution system.
- 2. Submit deferred Action Submittals such as Shop Drawings with supporting deferred informational submittals such as calculations no less than 4 weeks in advance of installation of component, equipment, or distribution system to be anchored to structure.

1.06 SOURCE QUALITY CONTROL

- A. Contractor and supplier responsibilities to accommodate Owner-furnished shop fabrication related special inspections and testing are provided in Project's Statement of Special Inspections in Supplement located at the end of Section 01 45 33, Special Inspection, Observation, and Testing, and Section 01 45 33, Special Inspection, Observation, and Testing.
- B. Provide all other specified, regulatory required, or required repair verification inspection and testing that is not listed in Statement of Special Inspections in accordance with Section 01 45 16.13, Contractor Quality Control.
- C. Provide Source Quality Control for welding and hot-dip galvanizing of anchors in accordance with Section 05 05 19, Anchor Bolts.

GRFF OZONE SYSTEM REPLACEMENT

PART 2 PRODUCTS

2.01 GENERAL

- A. Design and construct attachments and supports transferring seismic and non-seismic loads to structure of materials and products suitable for application and in accordance with design criteria shown on the Drawings and nationally recognized standards.
- B. Provide anchor bolts for anchorage of equipment to concrete or masonry in accordance with Section 05 05 19, Anchor Bolts. Provide anchor bolts of the size, minimum embedment, and spacing designated in calculations submitted by Contractor and accepted by Engineer.
- C. Provide post-installed concrete and masonry anchors for anchorage of equipment to concrete or masonry in accordance with Section 05 05 19, Anchor Bolts. Provide post-installed anchors of the size, minimum embedment, and spacing designated in calculations submitted by Contractor and accepted by Engineer.
- D. Do not use powder-actuated fasteners or sleeve anchors for seismic attachments and anchorage where resistance to tension loads is required. Do not use expansion anchors, other than undercut anchors, for nonvibration isolated mechanical equipment rated over 10 hp.

PART 3 EXECUTION

3.01 GENERAL

- A. Make attachments, bracing, and anchorage in such a manner that component lateral force is transferred to lateral force resisting system of structure through a complete load path.
- B. Design, provide, and install overall seismic anchorage system to provide restraint in all directions, including vertical, for each component or system so anchored.
- C. Provide snubbers in each horizontal direction and vertical restraints for components mounted on vibration isolation systems where required to resist overturning.
- D. Provide distribution system anchorage that maintains design flexibility and expansion capabilities at flexible connections and expansion joints.

- E. Anchor tall and narrow equipment such as motor control centers and telemetry equipment at base and within 12 inches from top of equipment, unless approved otherwise by Engineer.
- F. Do not attach architectural, mechanical, or electrical components to more than one element of a building structure at a single restraint location where such elements may respond differently during a seismic event. Do not make such attachments across building expansion and contraction joints.

3.02 INSTALLATION

- A. Do not install components or their anchorages or restraints prior to review and acceptance by Engineer and AHJ.
- B. Notify Engineer upon completion of installation of seismic restraints in accordance with Section 01 45 33, Special Inspection, Observation, and Testing.

3.03 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. In accordance with Section 05 05 19, Anchor Bolts.
- B. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.
- C. Provide any other specified, regulatory required, or required repair verification inspection and testing that is not listed in Statement of Special Inspections in accordance with Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 01 91 14
EQUIPMENT TESTING AND FACILITY STARTUP

PART 1 GENERAL

1.01 DEFINITIONS

- A. Facility: Entire Project, or an agreed-upon portion, including all of its unit processes.
- B. Factory Acceptance Test (FAT): Test or tests by manufacturer to demonstrate the purchased equipment is functional. Test results shall be submitted and approved by Engineer prior to shipment to Facility Site.
- C. Functional Demonstration Test (FDT): Test or tests by Contractor and Process and Instrumentation Controls System (PICS) Integrator on the associated PICS system equipment to demonstrate that it is operating in accordance with the facility operating requirements. Demonstrate each required control system function and mode.
- D. Functional Test: Test or tests in presence of Engineer and Owner to demonstrate that installed equipment meets manufacturer's installation, calibration, and adjustment requirements and other requirements as specified.
- E. Operational Readiness Test (ORT): Test or tests by Contractor and PICS Integrator to demonstrate prior to startup test period, inspect, test, and document that associated PICS system equipment are ready for operation.
- F. Performance Test: Test or tests performed after any required functional test in presence of Engineer and Owner to demonstrate and confirm individual equipment meets performance requirements specified in individual sections.
- G. Unit Process: Ozone System, Headworks Panel, and Sodium Bisulfite System.

1.02 SUMMARY OF RESPONSIBILITY

- A. Contractor is responsible for providing startup for all equipment supplied by the Contractor. Contractor is also responsible for providing assistance to the OSS during start-up of the Owner Furnished Products, as defined in Section 01 64 00, Owner-Furnished Products. Contractor shall be on-site and available for the duration of the ozone system startup and commissioning activities. Responsibilities include general troubleshooting and repairs or adjustments as needed for proper operation of the process piping, process equipment, instrumentation, and electrical systems.

GRFF OZONE SYSTEM REPLACEMENT

- B. Owner and Engineer are responsible for oversight of the Contractor, OSS, and PICS Integrator and general compliance with the Contract Documents.
- C. Ozone System Supplier (OSS) or Manufacturer is responsible for performing the functional and performance testing of Ozone control system, individual equipment units, and entire ozone system as defined in the Ozone Equipment Procurement Contract.
- D. PICS Integrator is responsible for supporting the OSS with inspection, Operational Readiness Tests and Functional Demonstration Testing, and documentation that associated Ozone Control System and associated equipment are ready for operation. PICS Integrator shall be on-site and available for the duration of the ozone system startup and commissioning activities to assist with troubleshooting.

1.03 SUBMITTALS

A. Informational Submittals:

- 1. Facility Startup Plan.
- 2. Functional and performance test results.
- 3. Unit Process Startup Form.

1.04 FACILITY STARTUP PLAN

- A. Develop a written plan, in conjunction with OSS and Owner's operations personnel; to include the following:
 - 1. Plan summary, including equipment names and tag numbers, overview of startup activities, and objectives of the Facility Startup Plan. Split out the testing requirements for the Ozone System and Sodium Bisulfite System.
 - 2. Sequence and schedule, including sequence of activities and anticipated date for each functional test, performance test, and Unit Process startup.
 - 3. Unit Process startup requirements.
 - 4. Test forms for each piece of equipment listing the specified tests to be performed and resultant data or check boxes.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Facility Startup Meetings: Schedule, in accordance with requirements of Section 01 31 19, Project Meetings.
 - 1. Contractor to provide Submittal for Start-up Schedule for Owner and Engineer review, in accordance with Section 01 33 00, Submittal Procedures.
- B. Contractor's Testing and Startup Representative:
 - 1. Designate and furnish one or more personnel to coordinate and expedite testing and facility startup.
 - 2. Representative(s) shall be present during startup meetings and shall be available at all times during testing and startup.
- C. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required for testing and startup.
- D. Provide Subcontractor and equipment manufacturers' staff adequate to prevent delays. Schedule ongoing work so as not to interfere with or delay testing and startup.
- E. Owner will:
 - 1. Provide water, power, chemicals, and other items as required for startup, unless otherwise indicated.
 - 2. Operate process units and facility with support of OSS, PICI, and Contractor.
 - 3. Provide labor and materials as required for laboratory analyses.
 - 4. Furnish assistance of manufacturer's representative(s) for Owner-furnished products, as specified in Section 01 64 00, Owner-Furnished Products.
 - 5. Make available spare parts, special tools, and operation and maintenance information for Owner-furnished products.

GRFF OZONE SYSTEM REPLACEMENT

3.02 EQUIPMENT TESTING

A. Preparation:

1. Complete installation before testing.
2. Contractor shall complete the OSS installation checklist and obtain and submit from ozone equipment manufacturer's representative Manufacturer's Certificate of Proper Installation Form.
3. Cleaning and Checking:
 - a. Prior to beginning functional testing:
 - 1) Follow OSS instructions for cleaning and checking procedures.
 - 2) Inspect and clean equipment, devices, connected piping, and structures to ensure they are free of foreign material.
 - 3) Prior to testing, Contractor to passivate all pipe welding and clean piping and equipment for oxygen or ozone service in accordance with Section 40 27 00, Process Piping—General.
 - 4) Lubricate equipment in accordance with manufacturer's instructions.
 - 5) Turn rotating equipment by hand when possible to confirm that equipment is not bound.
 - 6) Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
 - 7) Check power supply to electric-powered equipment for correct voltage.
 - 8) Adjust clearances and torque.
 - 9) Test piping for leaks.
4. Ready-to-test determination will be by Engineer based at least on the following:
 - a. Acceptable Operation and Maintenance Data.
 - b. Notification by Contractor of equipment readiness for testing and documentation of cleaning for oxygen service.
 - c. Receipt of Manufacturer's Certificate of Proper Installation.
 - d. Adequate completion of work adjacent to, or interfacing with, equipment to be tested.
 - e. Complete panel installation and land all control wiring before testing.
 - f. Equipment and electrical tagging complete.
 - g. Arc Flash Label installation complete.
 - h. Delivery of all spare parts and special tools.

B. Area 1 - Ozone Equipment and Instrument Testing:

1. Functional Testing:
 - a. OSS shall conduct testing as required by Ozone Equipment Procurement Contract in coordination with Owner, Engineer, and Contractor.
 - b. Contractor shall coordinate with OSS and PIC Integrator to schedule testing and notify Owner and Engineer in writing at least 10 days prior to scheduled date of testing.
 - c. Operational Readiness Testing (ORT):
 - 1) Follow test procedures outlined in Section 40 90 00, Instrumentation and Control for Process Systems.
 - 2) When, in Engineer's opinion, equipment meets Operational Readiness requirements specified in Section 40 90 00, Instrumentation and Control for Process Systems, such equipment will be accepted for purposes of advancing to Functional Demonstration testing phase. Such acceptance will be evidenced by Engineer/Owner's signature as witness on ORT Report.
 - d. When, in Engineer's opinion, equipment meets functional requirements specified, such equipment will be accepted for purposes of advancing to performance testing phase. Such acceptance will be evidenced by Engineer/Owner's signature as witness on Equipment Test Report.
2. Performance Testing:
 - a. OSS shall conduct testing as required by Ozone Equipment Procurement Contract in coordination with Owner, Engineer, and Contractor.
 - b. Testing duration shall be a minimum of 48 hours or as defined by the OSS.
 - c. Contractor shall coordinate with OSS to schedule testing and notify Owner and Engineer in writing at least 10 days prior to scheduled date of testing.
 - d. Performance testing shall not commence until equipment has been accepted by Engineer as having satisfied functional test requirements specified in the Ozone Equipment Procurement Contract.
 - e. Functional Demonstration Testing (FDT):
 - 1) Contractor shall coordinate with PIC integrator to complete Engineer witnessed FDT on the associated PIC system equipment to demonstrate that it is operating in accordance with the facility operating requirements. Demonstrate each required control system function.

GRFF OZONE SYSTEM REPLACEMENT

- 2) When, in Engineer's opinion, equipment meets Functional Demonstration Testing requirements specified in Section 40 90 00, Instrumentation and Control for Process Systems, such equipment will be accepted for purposes of advancing to Performance Testing the complete system. Such acceptance will be evidenced by Engineer/Owner's signature as witness on FDT Report.
- f. When, in Engineer's opinion, equipment meets performance requirements specified, such equipment will be accepted as to conforming to Contract requirements.

C. Area 2 – Headworks Panel Testing:

1. Functional Testing:
 - a. Contractor shall coordinate with PIC Integrator to schedule testing and notify Owner and Engineer in writing at least 10 days prior to scheduled date of testing.
 - b. Operational Readiness Testing (ORT):
 - 1) Follow test procedures outlined in Section 40 90 00, Instrumentation and Control for Process Systems.
 - 2) When, in Engineer's opinion, equipment meets Operational Readiness requirements specified in Section 40 90 00, Instrumentation and Control for Process Systems, such equipment will be accepted for purposes of advancing to Functional Demonstration testing phase. Such acceptance will be evidenced by Engineer/Owner's signature as witness on ORT Report.
 - c. Functional Demonstration Tests (FDTs): Once the ORT has been completed, perform a witnessed FDT on the associated PIC system equipment to demonstrate that it is operating in accordance with the facility operating requirements and as specified in Section 40 90 00, Instrumentation and Control for Process Systems. Demonstrate each required control system function.
 - d. When, in Engineer's opinion, equipment meets functional requirements specified, such equipment will be accepted for purposes of advancing to performance testing phase. Such acceptance will be evidenced by Engineer/Owner's signature as witness on Equipment Test Report.

D. Area 3 – Sodium Bisulfite Pumps and VFD Testing:

1. Functional Testing:
 - a. Contractor shall coordinate with PIC Integrator to schedule testing and notify Owner and Engineer in writing at least 10 days prior to scheduled date of testing.

- b. Operational Readiness Testing (ORT):
 - 1) Follow test procedures outlined in Section 40 90 00, Instrumentation and Control for Process Systems.
 - 2) When, in Engineer's opinion, chemical pump equipment meets Operational Readiness requirements specified in Section 40 90 00, Instrumentation and Control for Process Systems, such equipment will be accepted for purposes of advancing to Functional Demonstration testing phase. Such acceptance will be evidenced by Engineer/Owner's signature as witness on ORT Report.
 - c. Functional Demonstration Tests (FDTs): Once the ORT has been completed, perform a witnessed FDT on the associated PIC system equipment to demonstrate that it is operating in accordance with the facility operating requirements and as specified in Section 40 90 00, Instrumentation and Control for Process Systems. Demonstrate each required control system function.
 - d. When, in Engineer's opinion, equipment meets functional requirements specified, such equipment will be accepted for purposes of advancing to performance testing phase. Such acceptance will be evidenced by Engineer/Owner's signature as witness on Equipment Test Report.
2. Performance Testing:
- a. Contractor shall conduct testing as required by Section 44 44 13.01, Chemical Metering Pumps in coordination with Owner, Engineer, and Contractor.
 - b. Testing shall have a duration of a minimum of 24 hours.
 - c. Contractor shall coordinate with PIC Integrator to schedule testing and notify Owner and Engineer in writing at least 10 days prior to scheduled date of testing.
 - d. Performance testing shall not commence until equipment has been accepted by Engineer as having satisfied functional test requirements.
 - e. Functional Demonstration Testing (FDT):
 - 1) Contractor shall coordinate with PIC integrator to complete Engineer witnessed FDT on the associated PIC system equipment to demonstrate that it is operating in accordance with the facility operating requirements. Demonstrate each required control system function.
 - 2) When, in Engineer's opinion, equipment meets Functional Demonstration Testing requirements specified in Section 40 90 00, Instrumentation and Control for Process Systems, such equipment will be accepted for purposes of advancing to Performance Testing the complete system. Such acceptance will be evidenced by Engineer/Owner's signature as witness on FDT Report.

GRFF OZONE SYSTEM REPLACEMENT

- f. When, in Engineer's opinion, equipment meets performance requirements specified, such equipment will be accepted as conforming to Contract requirements.

3.03 UNIT PROCESS STARTUP

- A. Prior to unit process startup, equipment within unit process shall be accepted by Engineer as having met functional and performance testing requirements specified.
- B. Startup sequencing of unit processes shall be as chosen by Contractor to meet schedule requirements in coordination with Owner's plant process and constraints as described in Section 01 31 13, Project Coordination. Sodium Bisulfite System shall be fully tested and available to operate prior to testing of each of the Ozone Generators above the 50 percent power level.
- C. Startup shall be considered complete when, in opinion of Engineer, unit process has operated in manner intended for a minimum of 3 continuous days without significant interruption. This period is in addition to functional or performance test periods specified elsewhere.
- D. Significant interruption is any event that disrupts the process for greater than three hours, or as determined by Engineer.
- E. Challenge Testing shall be included during the Ozone System Unit Process Startup, as follows:
 - 1. Facility power loss and re-start, failure of an ozone generator, failure of a destruct unit, failure of an ozone injection pump, switching between operational modes, and other scenarios as selected by the Owner and Engineer.

3.04 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are a part of this specification:
 - 1. Unit Process Startup Form.
 - 2. Facility Performance Demonstration or Certification Form.

END OF SECTION

UNIT PROCESS STARTUP FORM

OWNER: _____ **PROJECT:** _____

Unit Process Description: (Include description and equipment number of all equipment and devices):

Startup Procedure (Describe procedure for sequential startup and evaluation, including valves to be opened/closed, order of equipment startup, etc.):

Startup Requirements (Water, power, chemicals, etc.): _____

Evaluation Comments: _____

FACILITY PERFORMANCE DEMONSTRATION/CERTIFICATION FORM

OWNER: _____ **PROJECT:** _____

Unit Processes Description (List unit processes involved in facility startup):

Unit Processes Startup Sequence (Describe sequence for startup, including computerized operations, if any):

Contractor Certification that Facility is capable of performing its intended function(s), including fully automatic operation:

Contractor: _____ **Date:** _____, 20____

Engineer: _____ **Date:** _____, 20____
(Authorized Signature)

**SECTION 02 41 00
DEMOLITION**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI): Guideline K, Containers for Recovered Non-flammable Fluorocarbon Refrigerants.
 2. American National Standards Institute (ANSI): A10.6, Safety Requirements for Demolition Operations.
 3. Environmental Protection Agency (EPA), U.S. Code of Federal Regulations (CFR), Title 40:
 - a. Part 61—National Emission Standards for Hazardous Air Pollutants.
 - b. Part 82—Protection of Stratospheric Ozone.
 - c. Part 273—Standards for Universal Waste Management.
 4. Occupational Safety and Health Administration (OSHA), U.S. Code of Federal Regulations (CFR) Title 29 Part 1926—Occupational Safety and Health Regulations for Construction.

1.02 DEFINITIONS

- A. ACM: Asbestos-containing material.
- B. Demolition: Dismantling, razing, destroying, or wrecking of any fixed building or structure or any part thereof. Demolition also includes removal of pipes, manholes tanks, conduit, and other underground facilities, whether as a separate activity or in conjunction with construction of new facilities.
- C. Modify: Provide all necessary material and labor to modify an existing item to the condition indicated or specified.
- D. Relocate: Remove, protect, clean and reinstall equipment, including electrical, instrumentation, and all ancillary components required to make the equipment fully functional, to the new location identified on the Drawings.

GRFF OZONE SYSTEM REPLACEMENT

- E. Renovation: Altering a facility or one or more facility components in any way.
- F. Salvage/Salvageable: Remove, and deliver to owner on pallet, to the specified location(s), the equipment, building materials, or other items so identified to be saved from destruction, damage, or waste; such property to remain that of Owner. Unless otherwise specified, title to items identified for demolition shall revert to Contractor.

1.03 SUBMITTALS

- A. Informational Submittals:
 - 1. Submit proposed Demolition/Renovation Plan, in accordance with requirements specified herein, for approval before such Work is started.
 - 2. Submit copies of any notifications, authorizations and permits required to perform the Work.

1.04 REGULATORY AND SAFETY REQUIREMENTS

- A. When applicable, demolition Work shall be accomplished in strict accordance with 29 CFR 1926-Subpart T.
- B. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the General Conditions, Contractor's safety requirements shall conform to ANSI A10.6.

1.05 DEMOLITION/RENOVATION PLAN

- A. Demolition/Renovation Plan shall provide for safe conduct of the Work and shall include:
 - 1. Detailed description of methods and equipment to be used for each operation.
 - 2. The Contractor's planned sequence of operations, including coordination with other work in progress.
 - 3. Motor Control Centers shall be de-energized while performing work within.
 - 4. Procedures for removal and disposition of materials specified to be salvaged.

1.06 SEQUENCING AND SCHEDULING

- A. The Work of this Specification shall not commence until Contractor's Demolition/Renovation Plan has been approved by Engineer.

- B. Include the Work of this Specification in the progress schedule, as specified in Section 01 32 00, Construction Progress Documentation.
- C. Areas in which the Work is to be accomplished will be available in accordance with the following schedule:
 - 1. Ozone Outage Window (January 4, 2027 – March 1, 2027).
 - 2. Ozone System Functionally Operational (All other times).

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXISTING FACILITIES TO BE DEMOLISHED OR RENOVATED

- A. Areas scheduled for selective demolition, partial demolition, and renovation Work are as shown on the Drawings.
- B. Concrete:
 - 1. Core drill corners of new opening to avoid overcutting adjacent reinforcing in existing concrete to remain. Saw concrete along straight lines to a depth of not less than 2 inches. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished Work, and the remaining concrete is sound.
 - 2. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete. Repair exposed rebar ends and embeds as shown on the Drawings.
 - 3. Where new concrete adjoins existing concrete, thoroughly clean and mechanically roughen existing concrete surfaces to roughness profile of 3/16-inch. Rebar and small embeds at existing concrete may be required to be left to engage new concrete. Saturate surface with water for 24 hours prior to placing new concrete. The new Work shall tie into the existing construction as shown on the Drawings.
- C. Patching:
 - 1. Where removals leave holes and damaged surfaces exposed in the finished Work, patch and repair to match adjacent finished surfaces as to texture and finish.
 - 2. Where new Work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new Work.

GRFF OZONE SYSTEM REPLACEMENT

3. Patching shall be as specified and indicated, and shall include:
 - a. Fill holes and depressions caused by previous physical damage or left as a result of removals in existing concrete with an approved patching material, applied in accordance with the manufacturer's printed instructions.

D. Electrical:

1. Cut off concealed or embedded conduit, boxes, or other materials a minimum of 3/4-inch below final finished surface.
2. When removing designated equipment, conduit and wiring may require rework to maintain service to other equipment.
3. Rework existing circuits, or provide temporary circuits as necessary during renovation to maintain service to existing lighting and equipment not scheduled to be renovated. Existing equipment and circuiting shown are based upon limited field surveys. Verify existing conditions, make all necessary adjustments, and record the Work on the Record Drawings. This shall include, but is not limited to, swapping and other adjustments to branch circuits and relocation of branch circuit breakers within panelboards as required to accomplish the finished work.
4. Reuse of existing luminaires, devices, conduits, boxes, or equipment will be permitted only where specifically indicated.
5. Protect in Place raceways and cabling scheduled for reuse.
6. Inaccessibly Concealed: Cut off and abandon in place.
7. Exposed or Concealed Above Accessible Ceilings: Remove.
8. Raceways and Cabling Scheduled for Future Use: Cap/seal and tag.
9. Relocating Equipment: Extend existing wiring or run new wiring from the source.
10. Surrender UPS batteries to Tacoma Public Utility for responsible recycling.
11. Where the existing raceway is concealed, the outlet box shall be cleaned, and a blank cover plate installed.
12. Where the concealed raceway is uncovered remove raceway (or extended to new location if appropriate).
13. Provide new typed panelboard circuit directory cards.

E. Control Panels:

1. In existing Headworks Control Panel, disconnect all wiring from existing redundant Siemens PLCs and salvage in place.
2. Disconnect wiring from all components and remove Sample Station back panels with Siemens PLC and remote I/O components mounted.
3. Seal removed back panels with plastic wrap and salvage to the Owner.
4. Coordinate with the Owner prior to removal to store salvaged back panels.

3.02 PROTECTION

- A. Building Occupancy: Refer to Section 01 31 13, Project Coordination, for specific requirements related to concurrent occupancy of facilities to be partially demolished.
- B. Dust and Debris Control:
 - 1. Collect and dispose of any shavings associated with cutting and demolishing of process piping.
 - 2. Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.
 - 3. Vacuum and dust the Work area daily.
- C. Traffic Control Signs: Where pedestrian and driver safety is endangered in the area of removal Work, use traffic barricades with flashing lights.
- D. Existing Work:
 - 1. Survey the site and examine the Drawings and Specifications to determine the extent of the Work before beginning any demolition or renovation.
 - 2. Take necessary precautions to avoid damage to existing items scheduled to remain in place, to be reused, or to remain the property of Owner; any Contractor-damaged items shall be repaired or replaced as directed by Engineer.
 - 3. Ensure that structural elements are not overloaded as a result of or during performance of the Work. Responsibility for additional structural elements or increasing the strength of existing structural elements as may be required as a result of any Work performed under this Contract shall be that of the Contractor. Repairs, reinforcement, or structural replacement must have Engineer approval.
 - 4. Do not overload pavements to remain.
- E. Weather Protection: For portions of the building scheduled to remain, protect building interior and materials and equipment from weather at all times.
- F. Facilities:
 - 1. Protect electrical and mechanical services and utilities.
 - 2. Protect all facility elements not scheduled for demolition.
 - 3. Utilize protective barriers and gas monitoring equipment during all indoor welding activities in accordance with permit approved by Owner.

GRFF OZONE SYSTEM REPLACEMENT

G. Protection of Personnel:

1. During demolition, continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site.
2. Provide temporary barricades and other forms of protection to protect Owner's personnel and the general public from injury due to demolition Work.
3. Provide protective measures as required to provide free and safe passage of Owner's personnel and the general public to occupied portions of the structure.

3.03 BURNING

- A. The use of burning at the Site for the disposal of refuse and debris will not be permitted.

3.04 RELOCATIONS

- A. Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Clean all items to be relocated prior to reinstallation, to the satisfaction of Engineer. Repair items to be relocated which are damaged or replace damaged items with new undamaged items as approved by Engineer.

3.05 BACKFILL

- A. Do not use demolition debris as backfill material.

3.06 TITLE TO MATERIALS

- A. All salvaged equipment will remain the property of Owner.
- B. All items designated to be removed, with the exception of equipment identified for salvage or relocation on the Drawings, shall become the property of the Contractor.

3.07 DISPOSITION OF MATERIAL

- A. Do not remove equipment and materials without approval of Contractor's Demolition/Renovation Plan by Engineer.
- B. Salvage equipment and material to the maximum extent possible.
- C. Remove materials and equipment that are indicated to be removed by Contractor and deliver to a storage site as directed.

- D. Remove salvaged items in a manner to prevent damage, and pack or crate to protect the items from damage while in storage or during shipment. Properly identify containers as to contents.
- E. Repair or replace, at the discretion of Engineer, items damaged during removal or storage.
- F. Remove salvaged items designated as the property of Owner in a manner to prevent damage
- G. Repair or replace, at the discretion of Engineer, items damaged during removal or storage.
- H. Stainless Steel passivation chemicals need to be disposed of in accordance with Tacoma Public Utility environmental policy.
- I. Owner will not be responsible for the condition or loss of, or damage to, property scheduled to become Contractor's property after Engineer's authorization to begin demolition. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

3.08 REUSE OF MATERIALS AND EQUIPMENT

- A. Remove and store materials and equipment listed in Article Title To Materials to be reused or relocated to prevent damage, and reinstall as the Work progresses.
- B. Properly store and maintain equipment and materials in same condition as when removed.
- C. Store equipment and material designated to be reused in a location designated by Owner.
- D. Equipment and material designated to be reused shall be cleaned, serviced and checked for proper operability before being put back into service.
- E. Engineer will determine condition of equipment and materials prior to removal.

GRFF OZONE SYSTEM REPLACEMENT

3.09 SPECIALIZED SALVAGE

A. Ozone Depleting Substances (ODS):

1. Class I and Class II ODS are defined in Section 602(a) and Section (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting AHRI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling.
2. Dispose of all Class I and Class II ODS refrigerants in accordance with the Clean Air Act Amendment of 1990.
3. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g., residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82.

3.10 UNSALVAGEABLE MATERIAL

- A. Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of in at the Contractor selected recycling and disposal facility.
- B. Combustible material shall be disposed of off the Site.

3.11 CLEANUP

- A. Debris and rubbish shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

END OF SECTION

**SECTION 03 30 10
CAST-IN-PLACE CONCRETE**

PART 1 GENERAL

1.01 GENERAL

- A. Unless otherwise specified, Work shall conform to requirements of ACI 301, Specifications for Concrete Construction (ACI 301).

1.02 REFERENCES

- A. In accordance with 1.4 Referenced standards of ACI 301 and the following:
 - 1. American Concrete Institute (ACI):
 - a. 301, Specifications for Concrete Construction.
 - b. 305.1, Specification for Hot Weather Concreting.
 - c. 306.1, Standard Specification for Cold Weather Concreting.
 - d. 308.1, External Curing of Cast-In-Place Concrete—Specification.
 - e. 350.1, Tightness Testing of Environmental Engineering Concrete Structures—Specification.
 - f. MNL-66, ACI Detailing Manual.
 - 2. ANSI/CRSI: RB 4.1, CRSI Standard for Supports for Reinforcement Used in Concrete.
 - 3. ASTM International (ASTM): D994/D994M, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
 - 4. Concrete Reinforcing Steel Institute (CRSI):
 - a. Manual of Standard Practice.
 - b. Placing Reinforcing Bars.
 - 5. National Ready Mixed Concrete Association (NRMCA).

1.03 DEFINITIONS

- A. Unless otherwise specified, refer to 1.3 Definitions of ACI 301.
- B. When a definition occurs in ACI 301 and this document, the definition given in this document governs.
- C. Cold Weather: When ambient temperature is below 40 degrees F or is approaching 40 degrees F and falling.

GRFF OZONE SYSTEM REPLACEMENT

- D. Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4-inch in diameter, cold joints, unless otherwise noted cracks at the surface of the concrete member that wider than 0.007-inch, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections. At exposed concrete, defective areas also include texture irregularities, stains, and other color variations that cannot be removed by cleaning.
- E. Exposed Concrete: Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when structure is drained. A concrete surface shall be considered exposed, even when the surface is specified to be covered by stain, paint, or coating.
- F. Hot Weather: As defined in ACI 305.1, Specification for Hot Weather Concreting (ACI 305.1).
- G. New Concrete: Concrete less than 60 days old.
- H. Top Bars: Horizontal bars placed such that 12 inches of fresh concrete is cast below in single placement.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Formwork and Formwork Accessories: Unless otherwise specified, conform to requirements of ACI 301.
 - b. Reinforcing steel prepared in accordance with CRSI Manual of Standard Practice and ACI MNL-66 Detailing Manual:
 - 1) Bending lists.
 - 2) Placing Drawings.
 - c. Construction Joints, Expansion Joints, and Control Joints: Layout and location for each type.
 - 2. Bagged Concrete:
 - a. Product data sheet.
 - b. Manufacturer's instructions:
 - 1) Mixing instructions.
 - 2) Placement instructions.
 - 3) Curing instructions.
 - 3. Concrete repair techniques.

B. Informational Submittals:

1. Manufacturer's application instructions for bonding agent and bond breaker.
2. Manufacturer's Certificate of Compliance to specified standards:
 - a. Bonding agent.
 - b. Bond breaker.
 - c. Repair materials.
3. Statement of Qualification:
 - a. Installer.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Flatwork Finisher: Unless otherwise permitted, at least one person on finishing crew shall be certified as an ACI Flatwork Finisher, or equivalent.

PART 2 PRODUCTS

2.01 GENERAL

- A. Unless otherwise specified, Work must be in accordance with ACI 301.

2.02 FORMWORK

A. Form Materials:

1. For exposed areas, use hard plastic finished plywood, overlaid waterproof particle board, or steel in new and undamaged condition, of sufficient strength and surface smoothness to produce specified finish.
2. For unexposed areas, use new shiplap or plywood.
3. Earth cuts may be used for forming footings.

- B. Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

C. Form Ties:

1. Material: Steel.
2. Spreader Inserts:
 - a. Conical or spherical type.
 - b. Design to maintain positive contact with forming material.

GRFF OZONE SYSTEM REPLACEMENT

- c. Furnish units that will leave no metal closer than 1-1/2 inches to concrete surface when forms, inserts, and tie ends are removed.
- 3. Wire ties not permitted.

2.03 CONCRETE

A. Materials:

- 1. Bagged Concrete:
 - a. Unless otherwise specified, provide the following for small concrete placements.
 - 1) Product for Small Concrete Placements:
 - a) Concrete product intended for use on small concrete placements, such as equipment pads, in full depth form and pour applications. Use shall be approved by the Owner. Not to be used in water holding applications.
 - b) One component cementitious concrete mix containing factory blended coarse aggregate.
 - c) Unless otherwise specified, nominal maximum size of coarse aggregate shall not exceed:
 - (1) Three-fourths of minimum clear spacing between reinforcement.
 - (2) One-fifth of the narrowest dimension between sides of forms.
 - (3) One-third of thickness of slabs or toppings.
 - d) Self-consolidating with maximum pour depth compatible with the required placement depth.
 - e) Contains integral corrosion inhibitor.
 - f) Compressive Strength, ASTM C39:
 - (1) 7 days, 4,500 pounds per square inch minimum.
 - (2) 28 days, 5,500 pounds per square inch minimum.
 - g) Drying Shrinkage, ASTM C157/C157M at 28 Days:
 - (1) 0.07 percent maximum.
 - (2) Chloride Ion Permeability Based on Charge Passed: ASTM C1202.
 - (3) 1800 Coulombs maximum.
 - h) Manufacturers and Products:
 - (1) Master Builders Solutions, Shakopee, MN; MasterEmaco S 440CI.
 - (2) Euclid Chemical Co. Cleveland, OH; EucoRepair SCC.
 - (3) Sika Corp., Lyndhurst, NJ; Sikacrete 211 SCC Plus.

- b. Unless otherwise specified, prepare design mixtures for each type and strength of concrete, selecting and proportioning ingredients in accordance with requirements of ACI 301.
 - c. Unless otherwise specified, selection of constituent materials and products in mix design are optional.
 - d. Unless otherwise permitted, use water-reducing admixture or water-reducing admixture and high-range, or water-reducing admixture for the following:
 - 1) Pumped concrete.
 - 2) Concrete with a water-cementitious materials ratio below 0.50.
 - 3) Concrete mixtures used in walls.
 - 4) When needed to achieve fresh properties that facilitate handling, placing, and consolidating of concrete mixtures, and to achieve specified hardened properties.
 - 5) When anticipated high temperatures, low humidity, or other adverse placement conditions can adversely affect fresh properties of concrete.
 - e. Unless otherwise specified, desired fresh properties of concrete shall be determined by Contractor, and coordinated with concrete producer. Fresh properties of concrete shall remain stable to satisfaction of Contractor, for duration of placement and consolidation, and shall remain in conformance with requirements of Contract Documents.
 - f. Contractor is encouraged to consider using environmentally sustainable concrete mix design technologies such as use of supplementary cementitious materials and aggregate packing, and self-consolidating concrete.
2. Water and Ice: Mixing water for concrete and water used to make ice shall be potable water, unless alternative sources of water are permitted.
- a. Water from alternative sources shall comply with requirements of ASTM C1602/C1602M, and concentration of chemicals in combined mixing water shall be less than:
 - 1) Chloride Content: 1,000 ppm.
 - 2) Sulfate Content as SO_4 : 3,000 ppm.
 - 3) Alkalis as $(\text{Na}_2\text{O} + 0.658 \text{ K}_2\text{O})$: 600 ppm.
 - 4) Total Solids by Mass: Less than 50,000 ppm.

2.04 REINFORCING STEEL

- A. Deformed Steel Reinforcing Bars: ASTM A615 or ASTM A706, Grade 60.
- B. Unless otherwise specified, welding of reinforcing bars is not permitted.
- C. Fabrication: Follow CRSI Manual of Standard Practice.

GRFF OZONE SYSTEM REPLACEMENT

2.05 ANCILLARY MATERIALS

A. Bonding Agent:

1. Unless otherwise specified, in accordance with the following:
 - a. ASTM C881/C881M, Type V.
 - b. Two-component, moisture-insensitive, 100 percent solids epoxy.
 - c. Consult manufacturer for surface finish, pot life, set time, vertical or horizontal application, and forming restrictions.
 - d. Manufacturers and Products:
 - 1) Master Builders Solutions, Shakopee, MN; MasterInject 1500.
 - 2) Euclid Chemical Co., Cleveland, OH; Euco No. 352 Epoxy System LV.
 - 3) Prime Resins, Conyers, GA; Prime Bond 3000 Series to 3900 Series.
 - 4) Sika Chemical Corp., Lyndhurst, NJ; Sikadur 32 Hi-Mod.

B. Bond Breaker:

1. Nonstaining type, providing positive bond prevention.
2. Manufacturers and Products:
 - a. Dayton Superior Corporation, Miamisburg, OH; Sure Lift J6WB.
 - b. Nox-Crete Products Group, Omaha, NE; Silcoseal Select.

C. Reinforcing Steel Accessories:

1. Plastic Protected Wire Bar Supports: In compliance with ANSI/CRSI – RB 4.1, Class 1 Reinforcement Supports.
2. Stainless Steel Protected Wire Bar Supports: In compliance with ANSI/CRSI – RB 4.1, Class 2 Reinforcement Supports, except legs shall be made wholly from stainless steel wire.
3. Precast Concrete Bar Supports: In compliance with ANSI/CRSI – RB 4.1 Cementitious (Precast) Reinforcement Supports.
 - a. Precast concrete bar supports shall have equal or greater strength than the surrounding concrete.
 - b. Precast concrete bar supports shall be 4 square inches minimum, in plan.
 - c. Precast concrete bar supports shall have tie wires.

D. Tie Wire:

1. Black, soft-annealed 16-gauge wire.
2. Nylon-coated, epoxy-coated, or plastic-coated wire.

E. Premolded Joint Filler:

1. Bituminous Type: ASTM D994/D994M or ASTM D1751.
2. Sponge Rubber:
 - a. Neoprene, closed-cell, expanded; ASTM D1056, Type 2C5, with compression deflection, 25 percent deflection (limits), 119 kPa to 168 kPa (17 pounds per square inch to 24 pounds per square inch) minimum.
 - b. Manufacturer and Product: Monmouth Rubber and Plastics Corporation, Long Branch, NJ; Durafoam DK515IHD.

F. Curing Compound:

1. Water-based, high-solids content, nonyellowing, curing compound meeting requirements of ASTM C1315 Type I, Class A.
2. Manufacturers and Products:
 - a. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.
 - b. WR Meadows, Inc., Hampshire, IL; VOCOMP-30.
 - c. Vexcon Chemical, Inc., Philadelphia, PA; Starseal 1315.
 - d. Dayton Superior; Safe Cure and Seal 1315 EF.

G. Evaporation Retardant:

1. Optional: Fluorescent fugitive dye color tint that disappears completely upon drying.
2. Manufacturers and Products:
 - a. Master Builders Solutions, Shakopee, MN; MasterKure ER 50.
 - b. Euclid Chemical Co., Cleveland, OH; Eucobar.

H. Repair Material:

1. Contain only trace amounts of chlorides and other chemicals that can potentially cause steel to oxidize.
2. Where repairs of exposed concrete are required, prepare mockup using proposed repair materials and methods, for confirmation of appearance compatibility prior to use.
3. Obtain Manufacturer's Certificate of Compliance that products selected are appropriate for specific applications.
4. Repair mortar shall be Site mixed.
5. Prepare concrete substrate and mix, place, and cure repair material in accordance with manufacturer's written recommendations.
6. Manufacturers and Products:
 - a. Master Builders Solutions, Shakopee, MN; MasterEmaco S Series products.
 - b. Sika Chemical Corp., Lyndhurst, NJ; SikaTop Series.

GRFF OZONE SYSTEM REPLACEMENT

I. Crack Repair:

1. Obtain Letter of Certification from manufacturer's technical representative, that products selected are appropriate for the specific applications.
2. Prepare concrete substrate and mix, place, and cure repair material in accordance with manufacturer's written recommendations.
3. Use part epoxy injection resin for structural crack repairs.
 - a. Manufacturers and Products:
 - 1) Master Builders Solutions, Shakopee, MN; MasterInject Series.
 - 2) Euclid Chemical Co., Cleveland, OH.; Euco Series (No. 452).
 - 3) Sika Chemical Corp., Lyndhurst, NJ.; Sikadur Series.
4. Use hydrophilic polyurethane injection resin for non-structural crack repairs.
 - a. Manufacturers and Products:
 - 1) Master Builders Solutions, Shakopee, MN; MasterInject 1210 IUG.
 - 2) Euclid Chemical Co., Cleveland, OH.; Dural Aqua-Fil.
 - 3) Sika Chemical Corp., Lyndhurst, NJ.; SikaFix HH Hydrophilic.
 - 4) Prime Resins, Inc., Conyers, GA.; Prime Flex 900 XLV.

2.06 SOURCE QUALITY CONTROL

- A. Source Quality Control Inspection: Owner shall have access to and have right to inspect batch plants, cement mills, and supply facilities of suppliers, manufacturers, and subcontractors, providing products included in this section.

PART 3 EXECUTION

3.01 FORMWORK

A. Form Construction:

1. Construct forms and provide smooth-form finish.
2. Form 3/4-inch bevels at concrete edges, unless otherwise shown.
3. Make joints tight to prevent escape of mortar and to avoid formation of fins.
4. Brace as required to prevent distortion during concrete placement.
5. On exposed surfaces, locate form ties in uniform pattern or as shown.
6. Construct so ties remain embedded in the member with no metal within 1-inch of concrete surface when forms, inserts, and tie ends are removed.

B. Form Removal:

1. Nonsupporting forms (walls and similar parts of Work) may be removed after cumulatively curing at not less than 50 degrees F for 24 hours from time of concrete placement if:
 - a. Concrete is sufficiently hard so as not to sustain damage by form removal operations.
 - b. Curing and protection operations are maintained.
2. Remove forms with care to prevent scarring and damaging the surface.
3. Prior to form removal, provide thermal protection for concrete being placed under the requirements of cold weather concreting.

3.02 PLACING REINFORCING STEEL

A. Unless otherwise specified, in accordance with ACI 301.

B. Unless otherwise specified, welding of reinforcing bars is not permitted.

C. Dowels: In accordance with 3.3.2.6 of ACI 301.

D. Field Bending or Straightening:

1. Field bending and straightening may be performed only once per reinforcing bar and shall be in accordance with 3.3.2.9 of ACI 301.
2. Unless otherwise specified, bend diameters shall comply with 3.3.2.8(c) of ACI 301.

E. Field Cutting Reinforcement: In accordance with 3.3.2.9 of ACI 301.

F. Accessories:

1. Bar Supports in Contact with Forms: Unless otherwise noted, bar supports shall be plastic protected wire bar supports, stainless steel protected wire bar supports, or precast concrete block bar supports.
 - a. Use stainless steel protected wire bar supports or precast concrete block bar supports at formed surfaces that will receive abrasive blasting, hydro-blasting, or grinding.
2. Bar Supports with No Special Requirements for Corrosion Resistance: Class 3 bar supports may be used in the following facilities, where the concrete surface in the finished construction will be in a dry conditioned space and will be concealed by architectural treatment such as ceiling or wall treatment, but not including sealer, paint, or other membrane coating.

GRFF OZONE SYSTEM REPLACEMENT

3. Bar supports shall have sufficient strength and stiffness to carry loads without failure, displacement, or significant deformation. Space bar supports so minimum concrete cover is maintained for reinforcing between supports, and location of reinforcement remains within tolerance throughout work.

G. Splices and Laps:

1. Lap Splice Reinforcing: Refer to Structural General Notes as shown on the Drawings for additional information.
2. Tie splices with 18-gauge annealed wire as specified in CRSI Standard.

3.03 CONCRETE PLACEMENT INTO FORMWORK

A. Inspection: Notify Owner at least 1-work-day in advance before starting to place concrete.

B. Placement into Formwork:

1. Reinforcement: Secure in position before placing concrete.
2. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 1.5 feet deep, except for slabs that shall be placed full depth. Place and consolidate successive layers prior to initial set of first layer to prevent cold joints.
3. Placement frequency shall be such that lift lines will not be visible in exposed concrete finishes.
4. Use means and methods that prevent segregation.
5. Provide sufficient illumination in the interior of forms so concrete deposition is visible, permitting confirmation of consolidation quality.
6. Joints in Footings and Slabs:
 - a. Ensure space beneath plastic waterstop completely fills with concrete.
 - b. During concrete placement, make visual inspection of entire waterstop area.
 - c. Limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift waterstop to confirm full consolidation without voids, and place remaining concrete to full height of slab.
 - d. Apply procedure to full length of waterstop.
7. Trowel and round off top exposed edges of walls with 1/4-inch radius steel edging tool.

C. Conveyor Belts and Chutes:

1. Design and arrange ends of chutes, hopper gates, and other points of concrete discharge throughout conveying, hoisting, and placing system for concrete to pass without becoming segregated.
2. Do not use chutes longer than 50 feet.
3. Wipe clean with device that does not allow mortar to adhere to belt.
4. Cover conveyor belts and chutes.

D. Retempering: Not permitted for concrete where cement has partially hydrated.

E. Pumping of Concrete:

1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to ensure completion of concrete placement without cold joints in case of primary placing equipment breakdown.
2. Minimum Pump Hose (Conduit) Diameter: 4 inches.
3. Replace pumping equipment and hoses (conduits) that are not functioning properly.

F. Maximum Size of Concrete Placements:

1. Limit size of each placement to allow for strength gain and volume change as a result of shrinkage.
2. Locate expansion, control, and contraction joints where shown.
3. Construction Joints:
 - a. Unless otherwise shown or permitted, locate construction joints as follows:
 - 1) Locate construction joints as shown on the Drawings or where approved in the joint location submittal.
 - 2) Locate expansion, control, and contraction joints where shown on the Drawings.
 - 3) Provide vertical construction joints at maximum spacing of 40 feet unless shown or approved otherwise.
 - 4) When vertical expansion, contraction, or control joint spacing does not exceed 60 feet, intermediate construction joints are not required.
 - 5) Uniformly space vertical construction joints within straight sections of walls, avoiding penetrations.

GRFF OZONE SYSTEM REPLACEMENT

G. Minimum Time between Adjacent Placements:

1. Typical Unless Noted Otherwise: As soon as can safely be done without damaging previously cast concrete or interrupting curing thereof, but not less than 24 hours.
2. Expansion or Contraction Joints: 1-day.
3. If continuous placement of beams, girders, or slabs with columns or walls is indicated in Contract Documents, do not place horizontal elements until the underlying concrete is consolidated and bleed water is not on the surface of the supporting member, unless otherwise specified.

3.04 CONSOLIDATION AND VISUAL OBSERVATION

- A. Provide at least one standby vibrator in operable condition at placement site prior to placing concrete.

3.05 COLD WEATHER PLACEMENT

- A. Cold weather placement of concrete is not permitted.

3.06 HOT WEATHER PLACEMENT

- A. Hot weather placement is not permitted.

3.07 CONCRETE BONDING

- A. Construction Joints at Existing Concrete:
 1. Thoroughly clean and roughen existing concrete surfaces to roughness profile range between CSP 7 to CSP 9 when verified by comparison to PC1-10.
 2. Saturate surface with water for 24 hours prior to placing new concrete.

3.08 PREMOLDED JOINT FILLER INSTALLATION

- A. Sufficient in width to completely fill joint space where shown.
- B. Drive nails approximately 1-foot 6 inches on center through filler, prior to installing, to provide anchorage embedment into concrete during concrete placement.
- C. Secure premolded joint filler in forms before concrete is placed.

3.09 FINISHING FORMED SURFACES

- A. Provide surface finish 2.0 (SF-2.0) in accordance with ACI 301 and as herein specified.
- B. Tie Holes: Unless otherwise specified, fill with specified repair material.
 - 1. Prepare substrate and mix, place, and cure repair material per manufacturer's written recommendations.
- C. Repair defective areas of concrete.
 - 1. Cut edges perpendicular to surface at least 1/2-inch deep. Do not feather edges. Soak area with water for 24 hours.
 - 2. Patch with specified repair material.
 - 3. Repair concrete surfaces using specified materials. Select system, submit for review, and obtain approval from Owner prior to use.
 - 4. Develop repair techniques with material manufacturer on surface that will not be visible in final construction prior to starting actual repair work and show how finish color will blend with adjacent surfaces. Obtain approval from Owner.
 - 5. Obtain quantities of repair material and manufacturer's detailed instructions for use to provide repair with finish to match adjacent surface or apply sufficient repair material adjacent to repair to blend finish appearance.
 - 6. Repair of concrete shall provide structurally sound surface finish, uniform in appearance or upgrade finish by other means until acceptable to Owner.
- D. Inject cracks that meet the definition of defective area.
 - 1. When crack repair is deemed by Owner as requiring a structural repair, use part epoxy injection resin.
 - 2. When crack repair is deemed by Owner as requiring a nonstructural repair, use hydrophilic polyurethane injection resin.

3.10 FINISHING UNFORMED SURFACES

- A. General:
 - 1. Use manual screeds, vibrating screeds, or roller compacting screeds to place concrete level and smooth.

GRFF OZONE SYSTEM REPLACEMENT

2. Do not use “jitterbugs” or other special tools designed for purpose of forcing coarse aggregate away from surface and allowing layer of mortar, which will be weak and cause surface cracks or delamination, to accumulate.
3. Do not dust surfaces with dry materials nor add water to surfaces.
4. Cure concrete as specified.

B. Slab Tolerances:

1. Exposed Slab Surfaces: Comprise of flat planes as required within tolerances specified.
2. Slab Finish Tolerances and Slope Tolerances: Crowns on floor surface not too high as to prevent 10-foot straightedge from resting on end blocks, nor low spots that allow block of twice the tolerance in thickness to pass under supported 10-foot straightedge.
3. Steel gauge block 5/16-inch thick.
4. Finish Slab Elevation: Slope slabs to floor drain and gutter, and shall adequately drain regardless of tolerances.
5. Thickness: Maximum 1/4-inch minus or 1/2-inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2-inch plus.

C. Interior Slab Finish: Provide trowel finish unless specified otherwise.

D. Exterior Slab Finish:

1. Provide broom finish unless specified otherwise.
2. Finish exposed edges with steel edging tool.
3. Mark sidewalks transversely at 5-foot intervals with jointing tool.

3.11 EXPOSED METAL OBJECTS

- A. Remove metal objects not intended to be exposed in as-built condition of structure including wire, nails, and bolts, by chipping back concrete to depth of 1-inch and then cutting or removing metal object.
- B. Repair area of chipped-out concrete as specified for defective areas.

3.12 BLOCKOUTS AT PIPES OR OTHER PENETRATIONS

- A. Where shown, install in accordance with requirements of the Drawings.

3.13 PROTECTION AND CURING

- A. Protect and cure concrete in accordance with requirements of ACI 301, ACI 308.1, External Curing of Cast-In-Place Concrete—Specification, and as follows:
 - 1. Protect fresh concrete from direct rays of sunlight, drying winds, and wash by rain.
 - 2. Continuously wet cure concrete surfaces of hydraulic structures for a 7-day period. Intermittent wetting is not acceptable.
 - 3. Use curing compound only where approved by Owner.
 - 4. Cure formed surfaces with curing compound applied in accordance with manufacturer's written instructions as soon as wet curing and finishing are completed.
 - 5. Remove and replace concrete damaged by freezing.
 - 6. Repair areas damaged by construction, using specified repair materials and approved repair methods.

3.14 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. General:
 - 1. Owner-Furnished Quality Assurance, in accordance with IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.
 - 2. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

3.15 MANUFACTURER'S SERVICES

- A. Admixture Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.
- B. Bonding Agent Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.

END OF SECTION

SECTION 05 05 19
ANCHOR BOLTS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Concrete Institute (ACI):
 - a. 318, Building Code Requirements for Structural Concrete.
 - b. 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
 - c. 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete.
 2. American Iron and Steel Institute (AISI): Stainless Steel Type 316.
 3. American National Standards Institute (ANSI).
 4. ASTM International (ASTM):
 - a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - b. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - c. A194/A194M, Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - d. E488/E488M, Standard Test Methods for Strength of Anchors in Concrete Elements.
 - e. F436/F436M, Standard Specification for Hardened Steel Washers.
 - f. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - g. F594, Standard Specification for Stainless Steel Nuts.
 - h. F1554, Standard Specification for Anchor Bolts, Steel, 36-ksi, 55-ksi, and 105-ksi Yield Strength.
 5. International Association of Plumbing and Mechanical Officials Uniform ES (IAPMO-UES): Evaluation Reports for Concrete and Masonry Anchors.
 6. International Code Council Evaluation Service (ICC-ES):
 - a. Evaluation Reports for Concrete and Masonry Anchors.
 - b. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
 - c. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements. Evaluation Reports for Concrete and Masonry Anchors.

GRFF OZONE SYSTEM REPLACEMENT

7. Specialty Steel Industry of North America (SSINA):
 - a. Specifications for Stainless Steel.
 - b. Design Guidelines for the Selection and Use of Stainless Steel.
 - c. Stainless Steel Fabrication.
 - d. Stainless Steel Fasteners.

1.02 DEFINITIONS

- A. Anchor Bolt: Cast-in-place or post-installed anchor; concrete or masonry.
- B. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.
- C. Exterior Area: Location not protected from weather by a building or other enclosed structure to include buried roof structures.
- D. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or wash down, and where wall or roof slab is not common to a water-holding or earth-retaining structure.
- E. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or wash down, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.
- F. Submerged: Location at or below top of wall of open water-holding structure, such as a basin or channel, or wall, ceiling, or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

- A. Action Submittals:
 1. Shop Drawings: Specific instructions for concrete anchor installation, including drilled hole size and depth, preparation, placement, procedures, and instructions for safe handling of anchoring systems.
- B. Informational Submittals:
 1. Concrete and Masonry Anchors:
 - a. Manufacturer's product description and installation instructions.
 - b. Current ICC-ES or IAPMO-UES Report for each type of post-installed anchor to be used.
 - c. Adhesive Anchor Installer Certification.
 2. Passivation method for stainless steel members.

3. Galvanizing coating applicator qualifications.
4. Hot-Dip Galvanizing: Certificate of Compliance signed by galvanizer, with description of material processed and ASTM standard used for coating.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Installers of adhesive anchors horizontally or upwardly inclined to support sustained tension loads shall be certified by an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Installer Certification Program or equivalent.
2. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package stainless steel items in a manner to provide protection from carbon impregnation.
- B. Protect hot-dip galvanized finishes from damage because of metal banding and rough handling.

PART 2 PRODUCTS

2.01 GENERAL

- A. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Stainless Steel:	
Anchor Bolts and Rods	F593, AISI Type 316, Group 2 Condition CW
Washers:	
Nuts*	F594, AISI Type 316, Condition CW

GRFF OZONE SYSTEM REPLACEMENT

Item	ASTM Reference
Carbon Steel:	
Anchor Bolts and Rods	F1554, Grade 36 or Grade 55 with weldability Supplement S1
Flat and Beveled Washers (Hardened)	F436/F436M
Nuts*	A563
Galvanized Steel:	
All	A153/A153M
*Nuts of other grades and styles having specified proof load stresses greater than specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than minimum tensile strength of specified threaded rod.	

- B. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, and zinc-plated steel material types as indicated in Fastener Schedule at end of this section.

2.02 ANCHOR BOLTS AND ANCHOR BOLT SLEEVES

A. Cast-In-Place Anchor Bolts:

1. Headed type, unless otherwise shown on the Drawings.
2. Material type and protective coating as shown in Fastener Schedule at end of this section.

B. Anchor Bolt Sleeves:

1. Plastic:
 - a. Single unit construction with corrugated sleeve.
 - b. Top of sleeve shall be self-threading to provide adjustment of threaded anchor bolt projection.
 - c. Material: High-density polyethylene.
2. Fabricated Steel: ASTM A36/A36M.

2.03 POST-INSTALLED CONCRETE ANCHORS

A. General:

1. AISI Type 316 stainless, hot-dip galvanized or zinc-plated steel, as shown in Fastener Schedule at end of this section.

2. Post-installed anchor systems used in concrete shall be approved by ICC Evaluation Services Report or equivalent for use in cracked concrete and for short-term and long-term loads including wind and earthquake.
 3. Mechanical Anchors: Comply with the requirements of ICC-ES AC193 or ACI 355.2.
 4. Adhesive Anchors: Comply with the requirements of ICC-ES AC308 or ACI 355.4.
- B. Torque-Controlled Expansion Anchors (Wedge Anchors):
1. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; KWIK Bolt-TZ2 Expansion Anchor Safe Set System with hollow drill bit and vacuum and SI-AT-A22 tool with adaptive torque for applicable sizes (ESR-4266).
 - b. DeWalt/Powers Fasteners, Brewster, NY; Power-Stud +SD1, +SD2, +SD4, or +SD6 Anchors (ESR-2502 and ESR-2818).
 - c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 Anchors (ESR-3037).
- C. Undercut Anchors:
1. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; HDA Undercut Anchor (ESR-1546).
 - b. DeWalt/Powers Fasteners, Brewster, NY; CCU+ Undercut Anchor (ESR-4810).
- D. Self-Tapping Concrete Screw Anchors:
1. Do not use for equipment anchorage unless specifically shown on the Drawings.
 2. Manufacturers and Products:
 - a. DeWalt/Powers Fasteners, Brewster, NY; Screw-Bolt+ (ESR-3889).
 - b. DeWalt/Powers Fasteners, Brewster, NY; Hangermate+ Rod Hanger Screw Anchor (ESR-3889).
 - c. DeWalt/Powers Fasteners, Brewster, NY; Snake+ Flush Mount Screw Anchor (ESR-2272).
 - d. Hilti, Inc., Tulsa, OK; Kwik HUS, KH-EZ, KH-EZ CRC, KH-EZ SS316, KH-EZ C, KH-EZ E, KH-EZ I, and KH-EZ P Screw Anchor Safe Set System with hollow drill bit and vacuum (ESR-3027).
 - e. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Titen HD Screw Anchor (ESR-2713 and IAPMO UES-493).

GRFF OZONE SYSTEM REPLACEMENT

E. Adhesive Anchors:

1. Threaded Rod:
 - a. Diameter as shown on the Drawings.
 - b. Length as required to provide minimum depth of embedment indicated and thread projection required.
 - c. Clean and free of grease, oil, or other deleterious material.
2. Adhesive:
 - a. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
 - b. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
3. Packaging and Storage:
 - a. Disposable, self-contained system capable of dispensing both components in proper mixing ratio and fitting into a manually or pneumatically operated caulking gun.
 - b. Store adhesive on pallets or shelving in a covered storage area.
 - c. Package Markings: Include manufacturer's name, product name, batch number, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
 - d. Dispose of When:
 - 1) Shelf life has expired.
 - 2) Stored other than in accordance with manufacturer's instructions.
4. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; HIT Doweling Anchor System, HIT-HY 200 V3 Safe Set System with HAS threaded rod (ESR-4868), HIT-RE 500 V3 Safe Set System with HAS threaded rod (ESR-3814), or HIT-RE 500 V3 Safe Set System with Hilti Roughening Tool (HIT RT) with HAS threaded rod (ESR-3814) for diamond cored holes.
 - b. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-3G Epoxy Adhesive Anchors. (ESR-4057).
 - c. DeWalt/Powers Fasteners, Brewster NY; Pure 220+ Epoxy adhesive anchor system with Dust X+ System (ESR-5144).

F. Adhesive Threaded Inserts:

1. Type 316 stainless steel, internally threaded inserts.
2. Manufacturer and Product: Hilti, Inc., Tulsa, OK; HIS-RN Insert with HIT-RE 500-V3 or HIT-HY 200 adhesive.

2.04 POST-INSTALLED MASONRY ANCHORS

- A. General: AISI Type 316 stainless, hot-dip galvanized, or zinc-plated steel, as shown in Fastener Schedule at end of section.
- B. Current ICC Evaluation Report indicating acceptance for anchors at structural applications in masonry.
- C. Manufacturers and Products:
 - 1. Hilti, Inc., Tulsa, OK; HIT-HY 270 Safe Set System with Hilti hollow drill bit and vacuum (ESR-4143) for solid grouted masonry, HIT-HY 200 V3 Safe Set System with Hilti hollow drill bit and vacuum (ESR-4878) for solid grouted masonry, HIT-HY 270 Safe Set System with Hilti hollow drill bit and vacuum (ESR-4144) for unreinforced masonry.
 - 2. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 (IAPMO ER 240) for grout filled CMU, Titen-HD (ESR-1056) for grout filled or hollow CMU, ET-3G (ESR-5309) for grout filled or hollow CMU.
 - 3. DeWalt/Powers Fasteners, Brewster NY; Power-Stud+ SD1 (ESR-2966) for grout-filled masonry, Screw-Bolt+ (ESR-4042) for grout-filled masonry, AC100+ Gold with Dust X+ System for unreinforced three-wythe brick (ESR-4105).

PART 3 EXECUTION

3.01 CAST-IN-PLACE ANCHOR BOLTS

- A. Locate and hold anchor bolts in place with templates at time concrete is placed.
- B. Use anchor bolt sleeves for location adjustment and provide two nuts and one washer per bolt of same material as bolt.
- C. Minimum Bolt Size: 1/2-inch diameter by 12 inches long, unless otherwise shown.

GRFF OZONE SYSTEM REPLACEMENT

3.02 POST-INSTALLED CONCRETE AND MASONRY ANCHORS

- A. Begin installation only after concrete or masonry to receive anchors is a minimum of 21 days old or has attained design strength whichever requires a longer duration.
- B. Locate existing reinforcing with ground penetrating radar or other method approved by the Engineer prior to drilling. Coordinate with the Engineer to adjust anchor locations where installation would result in hitting reinforcing.
- C. Install in accordance with written manufacturer's instructions.
- D. Provide minimum embedment, edge distance, and spacing as indicated on the Drawings.
- E. Use only drill type, bit type, and diameter recommended by anchor manufacturer. Use rotary hammer drill unless otherwise approved by the Engineer. Core drilling may only be used if specifically allowed by the Engineer.
- F. Clean hole of debris and dust per manufacturer's requirements.
- G. When unidentified embedded steel, rebar, or other obstruction is encountered in drill path, slant drill to clear obstruction. If drill must be slanted more than indicated in manufacturer's installation instructions to clear obstruction, notify the Engineer for direction on how to proceed.
- H. Adhesive Anchors:
 - 1. Unless otherwise approved by the Engineer and adhesive manufacturer:
 - a. Do not install adhesive anchors when temperature of concrete or masonry is below 40 degrees F or above 100 degrees F.
 - b. Do not install prior to concrete attaining an age of 21 days.
 - c. Remove any standing water from hole with oil-free compressed air. Inside surface of hole shall be dry.
 - d. Do not disturb anchor during recommended curing time.
 - e. Do not exceed maximum torque as specified in manufacturer's instructions.
 - 2. For hollow-unit masonry, install screen tube in accordance with manufacturer's instructions.
 - 3. Prestressed Concrete: Do not use drilled-in anchors in prestressed or post-tensioned concrete members without the Engineer's prior approval unless specifically shown on the Drawings.

3.03 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance:

1. In accordance with IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan in Supplement located at end of Section 01 45 33, Special Inspection, Observation, and Testing.
2. Contractor responsibilities and related information on special inspection, observation, and testing are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control:

1. Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.
2. Manufacturer's Certificate of Compliance per Section 01 61 00, Common Product Requirements, for test results, or calculations, or drawings that ensure material and equipment design and design criteria meet requirements of Section 01 61 00, Common Product Requirements, and Section 01 88 15, Anchorage and Bracing.

3.04 MANUFACTURER'S SERVICES

- A. Adhesive and Mechanical Anchors: Conduct Site training of installation personnel for proper installation, handling, and storage of adhesive anchor system. Notify the Engineer of time and place for sessions.

GRFF OZONE SYSTEM REPLACEMENT

3.05 FASTENER SCHEDULE

A. Unless indicated otherwise on the Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks
1. Anchors Into Concrete for Equipment Bases:		
Interior Dry Areas	Stainless steel anchors	Verify product acceptability and manufacturer's requirements if anchor installation will occur in an overhead application.
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel anchors	Verify product acceptability and manufacturer's requirements if anchor installation will occur in an overhead application.
2. Anchors in Grout-Filled Concrete Masonry Units:		
Interior Dry Areas	Hot-dip galvanized anchors	
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel anchors	
3. Anchors in Hollow Concrete Masonry Units:		
Interior Dry Areas	Hot-dip galvanized anchors	Adhesive anchors shall be installed with screen tubes.
Exterior, Interior Wet, and Corrosive Areas	Stainless steel anchors	Adhesive anchors shall be installed with screen tubes.
4. All Others:		
All service uses and locations	Stainless steel fasteners	

GRFF OZONE SYSTEM REPLACEMENT

- B. Antiseizing Lubricant: Use on all stainless steel threads.
- C. Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.

END OF SECTION

**SECTION 08 33 23
OVERHEAD COILING DOORS**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. ASTM International (ASTM):
 - a. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - b. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 2. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - c. MG 1, Motors and Generators.

1.02 SUBMITTALS

- A. Action Submittals:
1. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
 2. Product Data: General construction, component connections and details, wiring diagram and electrical equipment.
 3. Samples: Submit two door slats, 12-inch by 12-inch in size illustrating shape, color and finish texture.
- B. Informational Submittals:
1. Manufacturer's Instructions: Indicate installation sequence and procedures, and adjustment and alignment procedures.
 2. Operation and Maintenance Data, include lubrication requirements and frequency, and periodic adjustments required.

GRFF OZONE SYSTEM REPLACEMENT

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum 3 years documented experience.
2. Installer: Company specializing in performing work of this section with minimum 5 years approved by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Cookson Co.
2. Cornell Iron Works, Inc.
3. Basis of Design is Overhead Door Co.; Model 625 Insulated Stormtite.
4. "Or-equal."

2.02 GENERAL

- A. Wind Loads: Design door assembly to withstand wind/suction load of 20 psf (958 Pa), with maximum deflection of 1/120, and without damage to door or assembly components.
- B. Operation: Design door assembly including operator, to operate for not less than 20,000 cycles.
- C. Products Requiring Electrical Connection: Listed and classified by UL or another testing firm acceptable to authority having jurisdiction.
- D. Surface Burning Characteristics, Foam Insulation: Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

2.03 COMPONENTS

A. Curtain:

1. Conform to following:
 - a. Steel Slats:
 - 1) Interlocking, minimum 22 gauge (0.86 mm) thick of ASTM A653/A653M steel, minimum galvanized coating designation G60 (Z275) in accordance with ASTM A653/A653M.

- 2) Type: S-configuration slat. Sandwich slat construction with manufacturer's standard insulated core with R-value: 7.7.
 - 3) Color: Premium powder coating in color as selected from full range of standard colors.
 - b. Nominal Slat Size: 3 inches wide by required length.
 - c. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
 - d. Curtain Bottom: Fitted with angles, channels, or tubes to provide reinforcement and positive contact with floor in closed position.
- B. Guides:
1. Minimum 3/16 inch (5 mm) thick; galvanized steel conforming to ASTM A653/A653M, minimum galvanized coating designation G60 (Z275) in accordance with ASTM A653/A653M.
 2. Furnish continuous angles of profile to retain door in place with snap-on trim; mounting brackets of same metal.
- C. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension.
- D. Hood Enclosure and Fascia: Square shape, minimum 24 gauge (0.75 mm) thick galvanized steel internally reinforced to maintain rigidity and shape.
- E. Hardware:
1. Locks: Furnish locks to allow doors to be secured.
 - a. Electric Doors: Manufacturer's standard cylinder locking system to secure door; interlock with motor to prevent motor from operating when lock is activated.
 2. Cylinders: Match the existing style and type of the doors in the building.
 3. Weatherstripping (Exterior Assemblies): Moisture and rot proof, resilient type for complete weathertight installation.
 - a. Rubber, neoprene, or vinyl water seal at hood to prevent airflow around coil on exterior doors.
 - b. Weather seal sealing strip on guide to close space between guide and curtain on exterior doors.
- F. Electric Operation:
1. Electric motor operated unit with manual override in case of power failure.
 2. UL 325, side mounted, totally enclosed, nonventilated or fan-cooled motor.

GRFF OZONE SYSTEM REPLACEMENT

3. Motor Enclosure: NEMA MG1 Type 4 enclosure.
 4. Motor Rating: 1/2 hp; continuous duty.
 5. Motor Voltage: 230/460 volts three-phase, 60 Hz.
 6. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
 7. Controller Enclosure: NEMA 250 Type 4.
 8. Door Speed: 12 inches per second (300 mm/s).
 9. Brake: Adjustable friction clutch type, activated by motor controller.
 10. Control Station: Standard three button (OPEN-STOP-CLOSE) momentary on the inside of the door with a key operated controller on the exterior of each door, 24-volt circuit, surface mounted.
 11. Safety Edge: Manufacturer's standard safety edge and weatherseal located at door bottom, full width, sensitized type, wired to reverse upon striking object.
- G. Limit Switches: Door Operator shall be equipped with a fully adjustable, linear-driven or geared limit switch mechanism that synchronizes the operator position with the door position. Provide a dedicated set of auxiliary, dry contacts for remote indication of the door's fully closed position.
1. Alternative/Supplementary Sensor Option: Provide a door-mounted, industrial-grade, non-contact magnetic proximity sensor and a corresponding magnet for positive confirmation of the door's fully closed status.
 2. Sensor Type: Hermetically sealed magnetic reed switch contacts, rated for a minimum of 120V ac and 1A, with no additional power supply required (passive dry contacts).
 3. Enclosure Rating: Minimum NEMA 4X (weatherproof, corrosion-resistant).

2.04 FINISHES

- A. Curtain Slats: Steel, galvanized with A60 zinc coating in accordance with ASTM A653/A653M Prepare as required for final powder coat finish.
- B. Steel Guides and Hood Enclosure: Prepare for as required for powder coating. Color as selected by owner for manufacturers standard colors.

2.05 SOURCE QUALITY CONTROL

- A. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation board.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

- A. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- B. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- C. Complete wiring from disconnect to unit components and from fire alarm system to door operator.
- D. Install the specified proximity sensor or limit switch in the optimal location to reliably detect the door's fully closed position. Ensure all components are securely mounted and protected from impact or damage during normal operation.
 - 1. Provide all necessary conduit and wiring from the door operator/sensor location to Panel CP-32000 as indicated on the Electrical Drawings.
- E. Coordinate installation of sealants and backing materials at frame perimeter as required by door manufacturer.
- F. Install perimeter trim and closures.

3.03 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent Work.
- B. Maximum Variation from Plumb: 1/16 inch.
- C. Maximum Variation from Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 foot straight edge.

3.04 ADJUSTING

- A. Adjust door, hardware and operating assemblies for smooth and noiseless operation.

GRFF OZONE SYSTEM REPLACEMENT

3.05 CLEANING

- A. Leave door and components clean.
- B. Remove labels and visible markings.

3.06 TESTING

- A. Coordinate functional testing of the door status signal with Contractor's PIC Integrator. Verify that the PLC input changes state only when the door is in the fully closed and secured position.

END OF SECTION

**SECTION 09 29 01
GYPSUM BOARD**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. C475, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - b. C840, Standard Specification for Application and Finishing of Gypsum Board.
 - c. C1002, Standard Specification for Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases.
 - d. C1047, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - e. C1396, Specification for Gypsum Board.
 - f. D3273, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 - 2. Gypsum Association (GA):
 - a. 214, Levels of Gypsum Board Finishes.
 - b. 216, Recommended Specifications for Application and Finishing of Gypsum Board.

1.02 ENVIRONMENTAL CONDITIONS

- A. Temperature: Maintain between 55 degrees F and 70 degrees F for 24 hours before, during, and after application and finishing.
- B. Ventilation: Provide ventilation, but protect from drafts during hot, dry weather.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Fire-Rated Board: ASTM C1396, Type X, 5/8-inch thick with tapered edges.
- B. Fasteners:
 - 1. Screws: ASTM C1002, Type W or Type S, 1-1/4 inches.

GRFF OZONE SYSTEM REPLACEMENT

C. Joint Treatment:

1. Tape: ASTM C475, perforated; 2 inches wide, 10 by 10 glass mesh tape for soffit board.
2. Compound: ASTM C475, all-purpose, ready-mixed.

D. Metal Accessories:

1. ASTM C1047, galvanized metal.
2. Edge Trim: ASTM C840, Figure 1, L12 or Figure L-58.

PART 3 EXECUTION

3.01 APPLICATION OF GYPSUM BOARD

A. Inspection:

1. Verify that framing is aligned, spaced correctly, and does not exceed maximum allowable for gypsum board used.
2. Correct deficiencies before proceeding.

B. Application:

1. Meet requirements of ASTM C840 and GA-216.
2. Use gypsum board of maximum lengths to minimize end joints.
3. Use edge trim wherever gypsum board abuts another material.
4. Fasten gypsum board securely to framing using screws.
5. On intermediate and end supports, space fasteners 6 inches to 8 inches apart on walls.
6. Keep fasteners 3/8-inch from ends and edges of panels.
7. Drive fasteners to just below surface of gypsum board without breaking the surface paper.
8. Begin fastening in center of panel and work toward edges.

3.02 FINISHING

A. General: Meet requirements of ASTM C840; leave a flat, uniformly smooth surface ready for painting.

B. Taping and Finishing:

1. Apply tape properly for bond to gypsum board. When compound is dry, apply second and finishing coats in sufficient widths to form a smooth, even plane. After dry, lightly sand final coat. Do not raise nap of the paper when sanding.

GRFF OZONE SYSTEM REPLACEMENT

2. Finish: Conform to GA-214, Level 5.
 3. Leave gypsum board ready for painting.
- C. Fasteners: Cover fasteners, heads, and dents and gouges with three successive coats of finishing compound, each applied in a different direction.
- D. Edge Trim: Finish with successive coats of finishing compound so as to make the bead flush with the board surface.

END OF SECTION

SECTION 09 90 00
PAINTING AND COATING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
 - a. C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
 - b. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
 - c. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
 - d. C217, Microcrystalline Wax and Petrolatum Tape Coating Systems for Steel Water Pipe and Fittings.
2. Environmental Protection Agency (EPA).
3. NACE International (NACE): SP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
4. NSF International (NSF): 61, Drinking Water System Components - Health Effects.
5. Occupational Safety and Health Act (OSHA).
6. Research Council on Structural Connections (RCSC): Specification for Structural Joints using High-Strength Bolts.
7. The Society for Protective Coatings (SSPC):
 - a. PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements.
 - b. PA 10, Guide to Safety and Health Requirements for Industrial Painting Projects.
 - c. SP 1, Solvent Cleaning.
 - d. SP 2, Hand Tool Cleaning.
 - e. SP 3, Power Tool Cleaning.
 - f. SP 5, White Metal Blast Cleaning.
 - g. SP 6, Commercial Blast Cleaning.
 - h. SP 7, Joint Surface Preparation Standard Brush-Off Blast Cleaning.
 - i. SP 10, Near-White Blast Cleaning.
 - j. SP 11, Power Tool Cleaning to Bare Metal.

GRFF OZONE SYSTEM REPLACEMENT

- k. SP 16, Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
- l. SP 13, Surface Preparation of Concrete.

1.02 DEFINITIONS

A. Terms used in this section:

- 1. Coverage: Total minimum dry film thickness in mils or square feet per gallon.
- 2. FRP: Fiberglass Reinforced Plastic.
- 3. HCl: Hydrochloric Acid.
- 4. MDFT: Minimum Dry Film Thickness, mils.
- 5. MDFTPC: Minimum Dry Film Thickness per Coat, mils.
- 6. Mil: Thousandth of an inch.
- 7. PDS: Product Data Sheet.
- 8. PSDS: Paint System Data Sheet.
- 9. PVC: Polyvinyl Chloride.
- 10. SFPG: Square Feet per Gallon.
- 11. SFPGPC: Square Feet per Gallon per Coat.
- 12. SP: Surface Preparation.

1.03 SUBMITTALS

A. Action Submittals:

- 1. Shop Drawings:
 - a. Data Sheets:
 - 1) For each product, furnish a Paint Product Data Sheet (PPDS), the manufacturer's technical data sheets, and paint colors available (where applicable). The PPDS form is appended to the end of this section.
 - 2) For each paint system, furnish a Paint System Data Sheet (PSDS). The PSDS form is appended to the end of this section.
 - 3) Technical and performance information that demonstrates compliance with specification.
 - 4) Furnish copies of paint system submittals to the coating applicator.
 - 5) Indiscriminate submittal of only manufacturer's literature is not acceptable.
 - b. Detailed chemical and gradation analysis for each proposed abrasive material.

B. Informational Submittals:

1. Applicator's Qualification: List of references substantiating experience.
2. Coating manufacturer's Certificate of Compliance, in accordance with Section 01 43 33, Manufacturers' Field Services.
3. Factory Applied Coatings: Manufacturer's certification stating factory applied coating system meets or exceeds requirements specified.
4. Manufacturer's written verification that submitted material is suitable for the intended use.
5. If the manufacturer of finish coating differs from that of shop primer, provide finish coating manufacturer's written confirmation that materials are compatible.
6. Manufacturer's written instructions and special details for applying each type of paint.

1.04 QUALITY ASSURANCE

- A. Applicator Qualifications: Minimum 5 years' experience in application of specified products.
- B. Regulatory Requirements: Meet federal, state, and local requirements limiting the emission of volatile organic compounds.
- C. Surface Preparation and Coating Application:
1. Perform surface preparation and painting in accordance with recommendations of the following:
 - a. Paint manufacturer's instructions.
 - b. SSPC PA 10.
 - c. Federal, state, and local agencies having jurisdiction.
- D. Mockup:
1. Before proceeding with Work under this section, finish one complete space or item of each color scheme required showing selected colors, finish texture, materials, quality of work, and special details.
 2. After Engineer approval, sample spaces or items shall serve as a standard for similar work throughout the Project.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Shipping:
1. Where precoated items are to be shipped to the Site, protect coating from damage. Batten coated items to prevent abrasion.

GRFF OZONE SYSTEM REPLACEMENT

2. Protect shop painted surfaces during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.

B. Storage:

1. Store products in a protected area that is heated or cooled to maintain temperatures within the range recommended by paint manufacturer.
2. Primed surfaces shall not be exposed to weather for more than 2 months before being topcoated, or less time if recommended by coating manufacturer.

1.06 PROJECT CONDITIONS

A. Environmental Requirements:

1. Do not apply paint in temperatures or moisture conditions outside of manufacturer's recommended maximum or minimum allowable.
2. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Nationally recognized manufacturers of paints and protective coatings who are regularly engaged in the production of such materials for essentially identical service conditions.
- B. Minimum of 5 years' verifiable experience in manufacture of specified product.
- C. Each of the following manufacturers is capable of supplying most of the products specified herein:
 1. Akzo Nobel (Devoe; International).
 2. Carboline.
 3. PPG.
 4. Sherwin-Williams.
 5. Tnemec.
 6. Benjamin Moore Paint Company.
 7. "Or Approved Equal."

2.02 ABRASIVE MATERIALS

- A. Select abrasive type and size to produce surface profile that meets coating manufacturer's recommendations for specific primer and coating system to be applied.

2.03 PAINT MATERIALS

A. General:

1. Manufacturer's highest quality products suitable for intended service.
2. Compatibility: Only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats.
3. Thinners, Cleaners, Driers, and Other Additives: As recommended by coating manufacturer.

B. Products:

Product	Definition
Acrylic Latex	Single-component, finish as required.
Alkyd (Semigloss)	Semigloss alkyd.
Alkyd Wood Primer	Flat alkyd.
100% Solids NSF Epoxy	100% solids epoxy, capable of high film thickness build in one coat and suitable for immersion applications; approved for potable water contact and conforming to NSF 61.
Bituminous Paint	Single-component, coal-tar pitch based
Block Filler	Primer-sealer designed for rough masonry surfaces, 100% acrylic emulsion.
Epoxy Nonskid (Aggregated)	Polyamidoamine or amine converted epoxies aggregated; aggregate may be packaged separately.
Epoxy Primer—Ferrous Metal	Anticorrosive, converted epoxy primer containing rust-inhibitive pigments.
Epoxy Primer—Other	Epoxy primer, high-build, as recommended by coating manufacturer for specific galvanized metal, copper, or nonferrous metal alloy to be coated.
Fusion Bonded Coating	100% solids, thermosetting, fusion bonded, dry powder epoxy, suitable for the intended service.

GRFF OZONE SYSTEM REPLACEMENT

Product	Definition
Fusion Bonded Coating 100% Solids Epoxy	100% solids, thermosetting, fusion bonded, dry powder epoxy, suitable for the intended service.
High Build Epoxy	Polyamidoamine epoxy, minimum 69% volume solids, capability of 4 to 8 MDFT per coat.
Latex Primer Sealer	Waterborne vinyl acrylic primer/sealer for interior gypsum board and plaster. Capable of providing uniform seal and suitable for use with specified finish coats.
NSF Epoxy	Polyamidoamine epoxy, approved for potable water contact and conforming to NSF 61.
Polyurethane Enamel	Two-component, aliphatic or acrylic based polyurethane; high gloss finish.
Water Base Epoxy	Two-component, polyamide epoxy emulsion, finish as required.

2.04 MIXING

A. Multiple-Component Coatings:

1. Prepare using each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed beyond their pot life.
4. Furnish small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by paint manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

B. Colors: Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at Site.

2.05 SHOP FINISHES

A. Shop Blast Cleaning: Reference Paragraph, Shop Coating Requirements.

B. Surface Preparation: Provide Engineer minimum 7 days' advance notice to start of shop surface preparation work and coating application work.

C. Shop Coating Requirements:

1. When required by equipment specifications, such equipment shall be primed and finish coated in shop by manufacturer and touched up in field with identical material after installation.
2. Where manufacturer's standard coating is not suitable for intended service condition, Engineer may approve use of a tie-coat to be used between manufacturer's standard coating and specified field finish. In such cases, tie-coat shall be surface tolerant epoxy as recommended by manufacturer of specified field finish coat. Coordinate details of equipment manufacturer's standard coating with field coating manufacturer.

D. Pipe:

1. Steel Pipe:
 - a. Surface preparation and application of primer and finish coats shall be performed by pipe manufacturer.
 - b. For pipe with epoxy lining, do not place end cap seals until pipe lining material has sufficiently dried.

PART 3 EXECUTION

3.01 GENERAL

- A. Provide Engineer minimum 7 days' advance notice to start of field surface preparation work and coating application work.
- B. Perform the Work only in presence of Engineer, unless Engineer grants prior approval to perform the Work in Engineer's absence.
- C. Schedule inspection of cleaned surfaces and all coats prior to succeeding coat in advance with Engineer.

3.02 EXAMINATION

- A. Factory Finished Items:
 1. Schedule inspection with Engineer before repairing damaged factory-finished items delivered to Site.
 2. Repair abraded or otherwise damaged areas on factory-finished items as recommended by coating manufacturer. Carefully blend repaired areas into original finish. If required to match colors, provide full finish coat in field.

GRFF OZONE SYSTEM REPLACEMENT

- B. Surface Preparation Verification: Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.

3.03 PROTECTION OF ITEMS NOT TO BE PAINTED

- A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.
- B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.
- C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.
- D. Mask openings in motors to prevent paint and other materials from entering.
- E. Protect surfaces adjacent to or downwind of Work area from overspray.

3.04 SURFACE PREPARATION

- A. Field Abrasive Blasting:
 - 1. Perform blasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed or coated.
 - 2. Refer to coating systems for degree of abrasive blasting required.
 - 3. Where the specified degree of surface preparation differs from manufacturer's recommendations, the more stringent shall apply.
- B. Steel Surface Preparation:
 - 1. Where indicated, meet requirements of SSPC Specifications summarized below:
 - a. SP 1, Solvent Cleaning: Removal of visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants by cleaning with solvent.
 - b. SP 2, Hand Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using nonpower hand tools.
 - c. SP 3, Power Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using power-assisted hand tools.

- d. SP 5, White Metal Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter by blast cleaning.
 - e. SP 6, Commercial Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 33 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
 - f. SP 7, Brush-Off Blast Cleaning: Removal of visible rust, oil, grease, soil, dust, loose mill scale, loose rust, and loose coatings. Tightly adherent mill scale, rust, and coating may remain on surface.
 - g. SP 10, Near-White Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 5 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
 - h. SP 11, Power Tool Cleaning to Bare Metal: Removal of visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter using power-assisted hand tools capable of producing suitable surface profile. Slight residues of rust and paint may be left in lower portion of pits if original surface is pitted.
 - i. SP-16, Brush Blasting of Non-Ferrous Metals: A brush-off blast cleaned non-ferrous metal surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, metal oxides (corrosion products), and other foreign matter. Intact, tightly adherent coating is permitted to remain. A coating is considered tightly adherent if it cannot be removed by lifting with a dull putty knife. Bare metal substrates shall have a minimum profile of 19 micrometers (0.75 mil).
2. The words “solvent cleaning”, “hand tool cleaning,” “wire brushing,” and “blast cleaning,” or similar words of equal intent in these Specifications or in paint manufacturer’s specification refer to the applicable SSPC Specification.
 3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers’ recommendations for wet blast additives and first coat application shall apply.
 4. Hand tool clean areas that cannot be cleaned by power tool cleaning.

GRFF OZONE SYSTEM REPLACEMENT

5. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
6. Welds and Adjacent Areas:
 - a. Prepare such that there is:
 - 1) No undercutting or reverse ridges on weld bead.
 - 2) No weld spatter on or adjacent to weld or any area to be painted.
 - 3) No sharp peaks or ridges along weld bead.
 - b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
7. Preblast Cleaning Requirements:
 - a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
 - b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
 - c. Clean small isolated areas as above or solvent clean with suitable solvent and clean cloth.
8. Blast Cleaning Requirements:
 - a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.
 - b. Select type and size of abrasive to produce surface profile that meets coating manufacturer's recommendations for particular primer to be used.
 - c. Use only dry blast cleaning methods.
 - d. Do not reuse abrasive, except for designed recyclable systems.
 - e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.
9. Post-Blast Cleaning and Other Cleaning Requirements:
 - a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
 - b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.

C. Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation:

1. Remove soil, cement spatter, and other surface dirt with appropriate hand or power tools.
2. Brush blast in accordance with SSPC SP 16.
3. Obtain and follow coating manufacturer's recommendations for additional preparation that may be required.

D. Concrete Surface Preparation:

1. Do not begin until 30 days after concrete has been placed.
2. Meet requirements of SSPC SP 13.
3. Remove grease, oil, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent, or other suitable cleaning methods.
4. Brush-off blast clean to remove loose concrete and laitance, and provide a tooth for binding. Upon approval by Engineer, surface may be cleaned by acid etching method. Approval is subject to producing desired profile equivalent to No. 80 grit flint sandpaper. Acid etching of vertical or overhead surfaces shall not be allowed.
5. Secure coating manufacturer's recommendations for additional preparation, if required, for excessive bug holes exposed after blasting.
6. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to painting.

E. Wood Surface Preparation:

1. Replace damaged wood surfaces or repair in a manner acceptable to Engineer prior to start of surface preparation.
2. Solvent clean (mineral spirits) knots and other resinous areas and coat with shellac or other knot sealer, prior to painting. Remove pitch by scraping and wipe clean with mineral spirits or turpentine prior to applying knot sealer.
3. Round sharp edges by light sanding prior to priming.
4. Filler:
 - a. Synthetic-based wood putty approved by paint manufacturer for paint system.
 - b. For natural finishes, color of wood putty shall match color of finished wood.
 - c. Fill holes, cracks, and other surface irregularities flush with surrounding surface and sand smooth.
 - d. Apply putty before or after prime coat, depending on compatibility and putty manufacturer's recommendations.
 - e. Use cellulose type putty for stained wood surfaces.
5. Ensure surfaces are clean and dry prior to painting.

GRFF OZONE SYSTEM REPLACEMENT

- F. Gypsum Board Surface Preparation: Typically, new gypsum board surfaces need no special preparation before painting.
 - 1. Surface Finish: Dry, free of dust, dirt, powdery residue, grease, oil, or any other contaminants.
- G. Existing Painted Surfaces to be Repainted Surface Preparation:
 - 1. Detergent wash and freshwater rinse.
 - 2. Clean loose, abraded, or damaged coatings to substrate by hand or power tool, SP 2 or SP 3.
 - 3. Feather surrounding intact coating.
 - 4. Apply one spot coat of specified primer to bare areas, overlapping prepared existing coating.
 - 5. Apply one full finish coat of specified primer to entire surface.
 - 6. If an aged, plural-component material is to be topcoated, contact coating manufacturer for additional surface preparation requirements.
 - 7. Application of Cosmetic Coat:
 - a. It is assumed that existing coatings have oxidized sufficiently to prevent lifting or peeling when overcoated with paints specified.
 - b. Check compatibility by application to a small area prior to starting painting.
 - c. If lifting or other problems occur, request disposition from Engineer.
 - 8. Perform blasting as required to restore damaged surfaces. Materials, equipment, procedures shall meet requirements of SSPC.

3.05 SURFACE CLEANING

- A. Brush-off Blast Cleaning:
 - 1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC SP 7.
 - 2. Abrasive: Either wet or dry blasting sand, grit, or nutshell.
 - 3. Select various surface preparation parameters, such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.
 - 4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.
 - 5. Engineer will review acceptable trial blast cleaned area and use area as a representative sample of surface preparation.
 - 6. Repair or replace surface damaged by blast cleaning.
 - a. Thoroughly rinse to remove any residual acid surface condition that may impair adhesion.

7. Ensure surface is completely dry before application of coating.
8. Apply acid etching to obtain a “grit sandpaper” surface profile. If not, repeat treatment.

B. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods that involve a solvent or cleaning action.
2. Meet requirements of SSPC SP 1.

3.06 APPLICATION

A. General:

1. The intention of these Specifications is for existing and new gypsum board, and metal surfaces to be painted, whether specifically mentioned or not, except as specified otherwise. Do not paint exterior concrete surfaces, unless specifically indicated.
2. Extent of Coating (Immersion): Coatings shall be applied to internal vessel and pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless steel internals, unless otherwise specified.
3. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer’s written instructions for these requirements. Do not immerse coating until completion of curing cycle.
4. Apply coatings in accordance with these Specifications and paint manufacturers’ printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.
5. Sand wood lightly between coats to achieve required finish.
6. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
7. Fusion Bonded Coatings Method Application: Electrostatic, fluidized bed, or flocking.
8. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.
9. Water-Resistant Gypsum Board: Use only solvent type paints and coatings.
10. On pipelines, terminate coatings along pipe runs to 1 inch inside pipe penetrations.
11. Keep paint materials sealed when not in use.

GRFF OZONE SYSTEM REPLACEMENT

12. Where more than one coat is applied within a given system, alternate colors to provide a visual reference showing required number of coats have been applied.
- B. Galvanized Metal, Copper, and Nonferrous Metal Alloys:
1. Concealed galvanized, copper, and nonferrous metal alloy surfaces (behind building panels or walls) do not require painting, unless specifically indicated herein.
 2. Prepare surface and apply primer in accordance with System No. 10 specification.
 3. Apply intermediate and finish coats of the coating system appropriate for the exposure.
- C. Porous Surfaces, Such As Concrete and Masonry:
1. Filler/Surfacer: Use coating manufacturer's recommended product to fill air holes, bug holes, and other surface voids or defects.
 2. Prime Coat: May be thinned to provide maximum penetration and adhesion.
 - a. Type and Amount of Thinning: Determined by paint manufacturer and dependent on surface density and type of coating.
 3. Surface Specified to Receive Water Base Coating: Damp, but free of running water, just prior to application of coating.
- D. Film Thickness and Coverage:
1. Number of Coats:
 - a. Minimum required without regard to coating thickness.
 - b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
 2. Application Thickness:
 - a. Do not exceed coating manufacturer's recommendations.
 - b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.
 3. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
 - a. Perform with properly calibrated instruments.
 - b. Recoat and repair as necessary for compliance with specification.
 - c. Coats are subject to inspection by Engineer and coating manufacturer's representative.
 4. Visually inspect concrete, masonry, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.

5. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.
6. Apply additional coats as required to achieve complete hiding of underlying coats. Hiding shall be so complete that additional coats would not increase the hiding.

3.07 PROTECTIVE COATINGS SYSTEMS AND APPLICATION SCHEDULE

- A. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from Engineer before starting work in question.
- B. As shown in Finish Schedule on the Drawings. Additional requirements are included in the Piping Schedule.
- C. System No. 1 Submerged Metal—Potable Water:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 5, White Metal Blast Cleaning	NSF Epoxy	3 coats, 3 MDFTPC

1. Use on the following items or areas:
 - a. Metal surfaces new and existing below a plane 1-foot above the maximum liquid surface; metal surfaces above the maximum liquid surface that are a part of the immersed equipment; surfaces of metallic items, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel that are embedded in concrete; and the following specific surfaces:
 - 1) Interior surfaces of steel piping noted in the Piping Schedule.

- D. System No. 4 Exposed Metal—Highly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Epoxy Primer—Ferrous Metal	1 coat, 2.5 MDFT
	High Build Epoxy	1 coat, 4 MDFT
	Polyurethane Enamel	1 coat, 3 MDFT

1. Use on the following items or areas:
 - a. Exposed metal surfaces, located inside or outside of structures except where otherwise shown or specified.

GRFF OZONE SYSTEM REPLACEMENT

E. System No. 5 Exposed Metal—Mildly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Epoxy Primer—Ferrous Metal	1 coat, 2.5 MDFT
	Polyurethane Enamel	1 coat, 3 MDFT

1. Use on the following items or areas:
 - a. Exposed galvanized steel after System No. 10 application.
 - 1) Epoxy Primer – Other in System No. 10 shall replace Epoxy Primer – Ferrous Metal in System No. 5.
 - b. As indicated on Architectural Schedules on the Drawings. Miscellaneous metals not specified to be coated elsewhere.

F. System No. 10 Galvanized Metal, Copper, and Nonferrous Metal Alloy Conditioning:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation	Epoxy Primer—Other	As recommended by coating manufacturer Remaining coats as required for exposure

1. Use on the following items or areas:
 - a. Galvanized and copper surfaces requiring painting.
 - b. Exposed ends of galvanized steel pipe sleeves in contact with buried or submerged environments.
 - c. After application of System No. 10, apply finish coats as required for exposure.

3.08 ARCHITECTURAL PAINT SYSTEMS AND APPLICATION SCHEDULE

- A. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from Engineer before starting work in question.

GRFF OZONE SYSTEM REPLACEMENT

B. System No. 106 Galvanized Metal:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation	Manufacturer's Recommended Primer	1 coat, as recommended by manufacturer
	Alkyd Enamel (Semigloss)	2 coats, 4 MDFT

1. Use on the following items or areas:
 - a. Hollow metal frames and doors.

C. System No. 107 Metal Trim and Structural Steel:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 6, Commercial Blast Cleaning	Rust-Inhibitive Primer	1 coat, 2 MDFT
	Alkyd Enamel (Semigloss)	2 coats, 4 MDFT

1. Use on the following items or areas:

D. System No. 113 Concrete, Semigloss:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Concrete Surface Preparation	Acrylic Latex (Semigloss)	2 coats, 240 SFPGPC

GRFF OZONE SYSTEM REPLACEMENT

E. System No. 115 Gypsum Board, Semigloss:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Gypsum Board Surface Preparation	Latex Primer/Sealer	1 coat, 350 SFPG
	Acrylic Latex (Semigloss) or Alkyd (Semigloss)	2 coats, 400 SFPGPC

3.09 COLORS

- A. Provide as selected by Owner or Engineer.
- B. Proprietary identification of colors is for identification only. Selected manufacturer may supply matches.
- C. Equipment Colors:
- Equipment includes the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits.
 - Paint equipment and piping one color as selected.
 - Match existing colors when replacing a portion of piping.
 - Paint nonsubmerged portions of equipment the same color as the piping it serves, except as itemized below:
 - Dangerous Parts of Equipment and Machinery: OSHA Orange.
 - Fire Protection Equipment and Apparatus: OSHA Red.
 - Radiation Hazards: OSHA Purple.
 - Physical hazards in normal operating area and energy lockout devices, including, but not limited to, electrical disconnects for equipment and equipment isolation valves in air and liquid lines under pressure: OSHA Yellow.
- D. Pipe Identification Painting:
- Color code nonsubmerged metal piping, except electrical conduit. Paint fittings and valves the same color as pipe, except equipment isolation valves.
 - Pipe Color Coding: In accordance with Piping Schedule and Piping Data Sheets.
 - Pipe Supports: Painted light gray, as approved by Owner.

4. Fiberglass reinforced plastic (FRP) pipe, polyvinylidene fluoride (PVDF), and polyvinyl chloride (PVC) pipe located inside of buildings and enclosed structures will not require painting, except as noted or scheduled.

3.10 FIELD QUALITY CONTROL

A. Testing Equipment:

1. Provide calibrated electronic type dry film thickness gauge to test coating thickness specified in mils.
2. Provide low-voltage wet sponge electrical holiday detector to test completed coating systems, 20 mils dry film thickness or less, except zinc primer, high-build elastomeric coatings, and galvanizing, for pinholes, holidays, and discontinuities, as manufactured by Tinker and Rasor, San Gabriel, CA, Model M-1.
3. Provide high-voltage spark tester to test completed coating systems in excess of 20 mils dry film thickness. Unit as recommended by coating manufacturer.

B. Testing:

1. Thickness and Continuity Testing:
 - a. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2. Check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.
 - b. Holiday detect coatings 20 mils thick or less, except zinc primer and galvanizing, with low voltage wet sponge electrical holiday detector in accordance with NACE SP0188.
 - c. Holiday detect coatings in excess of 20 mils dry with high voltage spark tester as recommended by coating manufacturer and in accordance with NACE SP0188.
 - d. After repaired and recoated areas have dried sufficiently, retest each repaired area. Final tests may also be conducted by Engineer.

C. Inspection: Leave staging and lighting in place until Engineer has inspected surface or coating. Replace staging removed prior to approval by Engineer. Provide additional staging and lighting as requested by Engineer.

D. Unsatisfactory Application:

1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.

GRFF OZONE SYSTEM REPLACEMENT

2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
3. Repair defects in accordance with written recommendations of coating manufacturer.

E. Damaged Coatings, Pinholes, and Holidays:

1. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
2. Remove rust and contaminants from metal surface. Provide surface cleanliness and profile in accordance with surface preparation requirements for specified paint system.
3. Feather edges and repair in accordance with recommendations of paint manufacturer.
4. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.11 MANUFACTURER'S SERVICES

- A. In accordance with Section 01 43 33, Manufacturers' Field Services, coating manufacturer's representative shall be present at Site as follows:
1. On first day of application of any coating system.
 2. A minimum of one additional Site inspection visits, for a minimum of 4 hours, in order to provide Manufacturer's Certificate of Proper Installation.
 3. As required to resolve field problems attributable to or associated with manufacturer's product.
 4. To verify full cure of coating prior to coated surfaces being placed into immersion service.

3.12 CLEANUP

- A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at end of each day.
- B. Upon completion of the Work, remove staging, scaffolding, and containers from Site or destroy in a legal manner.
- C. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

3.13 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are a part of this specification:

1. Paint System Data Sheet (PSDS).
2. Paint Product Data Sheet (PPDS).

END OF SECTION

PAINT SYSTEM DATA SHEET (PSDS)

Complete this PSDS for each coating system, include all components of the system (surface preparation, primer, intermediate coats, and finish coats). Include all components of a given coating system on a single PSDS.

Paint System Number (from Spec.):		
Paint System Title (from Spec.):		
Coating Supplier:		
Representative:		
Surface Preparation:		
Paint Material (Generic)	Product Name/Number (Proprietary)	Min. Coats, Coverage

PAINT PRODUCT DATA SHEET (PPDS)

Complete and attach manufacturer's Technical Data Sheet to this PPDS for each product submitted. Provide manufacturer's recommendations for the following parameters at temperature (F)/relative humidity:

Temperature/RH	50/50	70/30	90/25
Induction Time			
Pot Life			
Shelf Life			
Drying Time			
Curing Time			
Min. Recoat Time			
Max. Recoat Time			

Provide manufacturer's recommendations for the following:

Mixing Ratio: _____

Maximum Permissible Thinning: _____

Ambient Temperature Limitations: min.: _____ max.: _____

Surface Temperature Limitations: min.: _____ max.: _____

Surface Profile Requirements: min.: _____ max.: _____

Attach additional sheets detailing manufacturer's recommended storage requirements and holiday testing procedures.

SECTION 26 05 02
BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED SECTIONS

- A. Requirements specified within this section apply to Division 26, Electrical. Work specified herein shall be performed as if specified in the individual sections.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. IEEE 1584.2, IEEE 1584.2-2025.
 - b. IEEE Guide and Checklists for Data Collection for Performing Arc Flash Hazard Calculation Study in accordance with IEEE 1584 and IEEE 1584.1 for Systems Operating at three-phase 50/60 Hz 1,000 Volts and below.
 - c. IEEE 519 Standard for Harmonic Control in Electric Power Systems.
 - 2. National Electrical Contractors Association (NECA): National Electrical Installation Standards.
 - 3. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. Z535.4, Product Safety Signs and Labels.
 - 4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 - 5. NFPA 70E Electrical Safety in the Workplace.
 - 6. NEMA Z535.4 Guide to Product Safety Signs and Labeling.

1.03 DESIGN REQUIREMENTS

- A. Provide anchorage and bracing design drawings, calculations, and related information where required under Section 01 88 15, Anchorage and Bracing.
- B. Provide seismic certification per requirements of Section 01 45 33, Special Inspection, Observation, and Testing, where required in that section for electrical equipment listed.

GRFF OZONE SYSTEM REPLACEMENT

1.04 SUBMITTALS

A. Action Submittals:

1. Provide manufacturers' data for the following:
 - a. Nameplates, signs, and labels.
2. Anchorage and bracing drawings and catalog information, as required by Section 01 88 15, Anchorage and Bracing, for loads in Section 01 61 00, Common Product Requirements.

B. Informational Submittals: Anchorage and bracing calculations, as required by Section 01 88 15, Anchorage and Bracing, for loads in Section 01 61 00, Common Product Requirements.

1.05 QUALITY ASSURANCE

- A. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.
- B. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark or label.
- C. Provide materials and equipment acceptable to AHJ for Class, Division, and Group of hazardous area indicated.

PART 2 PRODUCTS

2.01 GENERAL

- A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.
- B. Material and equipment installed in heated and ventilated areas shall be capable of continuous operation at their specified ratings within an ambient temperature range of 40 degrees F to 104 degrees F.
- C. Materials and equipment installed outdoors shall be capable of continuous operation at their specified rating within the ambient temperature range stated in Section 01 61 00, Common Product Requirements, including indoor areas that are not heated or ventilated.

2.02 EQUIPMENT FINISH

- A. Manufacturer's ANSI 61 standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with manufacturer's standard gray color finish as approved by Owner.

2.03 NAMEPLATES

- A. Material: Laminated plastic.
- B. Attachment Screws:
 - 1. Stainless steel.
 - 2. Adhesive: Single-part, room temperature vulcanizing adhesive suitable for the environment and materials installed. Use adhesive on NEMA 4 or NEMA 4X enclosures only.
- C. Color: Black, engraved to a white core with beveled edges.
- D. Letter Height:
 - 1. Pushbuttons/Selector Switches: 1/8-inch.
 - 2. Other Electrical Equipment: 1/4-inch.

2.04 SIGNS AND LABELS (NOT INCLUDING ARC FLASH LABELS)

- A. Sign size, lettering, and color shall be in accordance with NEMA Z535.4.

PART 3 EXECUTION

3.01 GENERAL

- A. The Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned. Contractor shall be responsible for actual location of equipment and devices and for proper routing and support of raceways, subject to approval of Engineer.
- B. Check approximate locations of light fixtures, switches, electrical outlets, equipment, and other electrical system components shown on the Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify Engineer in writing.
- C. Install work in accordance with NECA Standard of Installation, unless otherwise specified.

GRFF OZONE SYSTEM REPLACEMENT

- D. Keep openings in boxes and equipment closed during construction.
- E. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Engineer. Carefully perform cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces to original condition.
- F. Protect equipment from any flying metal shavings and removing any shavings from enclosure interiors.

3.02 ANCHORING, BRACING, AND MOUNTING

- A. Equipment anchoring and mounting shall be in accordance with manufacturer's requirements for Project design criteria provided in Section 01 61 00, Common Product Requirements, to meet the requirements of Section 01 88 15, Anchorage and Bracing.

3.03 COMBINING CIRCUITS INTO COMMON RACEWAY

- A. Homerun circuits shown on the Drawings indicate functional wiring requirements for power and control circuits. Circuits may be combined into common raceways in accordance with the following requirements:
 - 1. Analog control circuits from devices in same general area to same destination.
 - a. No power or AC discrete control circuits shall be combined in same conduit with analog circuits.
 - b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, paging system circuits shall be combined with power or Class 1 circuits.
 - c. Analog circuits shall be continuous from source to destination. Do not add TJB (terminal junction boxes), splice, or combine into a multi-pair cable without authorization of Engineer.
 - d. Raceways shall be sized per General Circuit and Raceway Schedule and do not exceed 40 percent fill.
 - e. Changes shall be documented on a regular basis on one set of construction drawings in the construction area and on the Record Drawings.
 - 2. Discrete control circuits from devices in the same general area to the same destination.
 - a. No power or analog control circuits shall be combined in same conduit with discrete circuits.

- b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, and paging system circuits shall be combined with power or Class 1 circuits.
 - c. Raceways shall be sized per the General Circuit and Raceway Schedule and do not exceed 40 percent fill unless permitted by the NEC.
 - d. Changes shall be documented on the Record Drawings.
3. Power circuits from loads in same general area to same source location (such as: panelboard, switchboard, low voltage motor control center).

3.04 NAMEPLATES, SIGNS, AND LABELS

- A. Arc Flash Protection Warning Signs: Field mark panelboards to warn qualified persons of potential arc-flash hazards. Locate marking so to be clearly visible to persons before working on energized equipment.
- B. Available Fault Current Signs:
 - 1. Install label on service equipment to indicate the maximum available fault current at the equipment. Labels shall be of sufficient durability for the environment in which the equipment is installed. Labels shall include the following information:
 - a. Equipment name or identification.
 - b. Available fault current at the equipment.
 - c. Date the fault current calculations were performed.
 - 2. Use bolted fault current and equipment name from Engineer as basis for the label.
 - 3. Completely remove existing fault current labels if present, and install new labels on all equipment shown on the one-lines in accordance with the above requirements and NFPA70E.
- C. Multiple Power Supply Sign: Install permanent plaque or directory at each service disconnect location denoting other services, feeders, and branch circuits supplying the building, and the area served by each.
- D. Equipment Nameplates:
 - 1. Provide a nameplate to label electrical equipment including switchgear, switchboards, motor control centers, panelboards, motor starters, transformers, terminal junction boxes, disconnect switches, switches and control stations.
 - 2. Switchgear, motor control center, transformer, and terminal junction box nameplates shall include equipment designation.

GRFF OZONE SYSTEM REPLACEMENT

3. Disconnect switch, motor starter, and control station nameplates shall include name and number of equipment powered or controlled by that device.
4. Switchboard, transformer, and panelboard nameplates shall include equipment designation, service voltage, and phases.

3.05 LOAD BALANCE

- A. The Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.
- B. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.
- C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made on the floor construction drawings, and provide circuit directory that lists final circuit arrangement.

3.06 CLEANING AND TOUCHUP PAINTING

- A. Cleaning: Throughout the Work, clean interior and exterior of devices and equipment by removing debris and vacuuming.
- B. Touchup Paint:
 1. Touchup scratches, scrapes, and chips on exterior and interior surfaces of devices and equipment with finish matching type, color, and consistency and type of surface of original finish.
 2. If extensive damage is done to equipment paint surfaces, refinish entire equipment in a manner that provides a finish equal to or better than factory finish, that meets requirements of Specification, and is acceptable to Engineer.
 3. Provide unopened spare touch-up paint.

3.07 PROTECTION FOLLOWING INSTALLATION

- A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation and contact surfaces.
- B. When equipment intended for indoor installation is installed at Contractor's convenience in areas where subject to dampness, moisture, dirt, or other adverse atmosphere until completion of construction, ensure adequate protection from these atmospheres is provided and acceptable to Engineer.

END OF SECTION

SECTION 26 05 04
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. ASTM International (ASTM):
 - a. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy Formability.
 - b. E814, Method of Fire Tests of Through-Penetration Fire Stops.
 2. Canadian Standards Association (CSA).
 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 18, Standard for Shunt Power Capacitors.
 4. International Society of Automation (ISA): RP12.06.01, Wiring Practices for Hazardous (Classified) Locations Instrumentation–Part 1: Intrinsic Safety.
 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. C12.1, Code for Electricity Metering.
 - c. C12.6, Phase-Shifting Devices Used in Metering, Marking and Arrangement of Terminals.
 - d. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - e. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
 - f. KS 1, Enclosed and Miscellaneous Distribution Switches (600 Volts Maximum).
 - g. ANSI C119 American National Standard for Electrical Connectors.
 6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 7. UL:
 - a. 98, Standard for Enclosed and Dead-Front Switches.
 - b. 248, Standard for Low Voltage Fuses.
 - c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
 - d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
 - e. 508, Standard for Industrial Control Equipment.

GRFF OZONE SYSTEM REPLACEMENT

- f. 810, Standard for Capacitors.
- g. 943, Standard for Ground-Fault Circuit-Interrupters.
- h. 1059, Standard for Terminal Blocks.
- i. 1479, Fire Tests of Through-Penetration Fire Stops.
- j. 60947 Low Voltage Switchgear and Controlgear.

1.02 SUBMITTALS

A. Action Submittals:

- 1. Provide manufacturers' data for the following:
 - a. Control devices.
 - b. Control relays.
 - c. Circuit breakers.
 - d. Fused switches.
 - e. Nonfused switches.
 - f. Timers.
 - g. Fuses.
 - h. Magnetic contactors.
 - i. Intrinsic safety barriers.
 - j. Firestopping.
 - k. Enclosures: Include enclosure data for products having enclosures.
 - l. Variable frequency drives
 - m. MCC buckets with components.
 - n. Uninterruptible power supplies, including batteries.
 - o. Elapsed time meters.
 - p. Terminal blocks.
 - q. Splice kits.
- 2. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals: Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

1.03 EXTRA MATERIALS

- #### A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:
- 1. Fuses, 0-Volt to 600 Volts: Six of each type and each current rating installed.
 - 2. Test device to test circuit breaker electronic trip units.

PART 2 PRODUCTS

2.01 MOLDED CASE CIRCUIT BREAKER THERMAL MAGNETIC, LOW VOLTAGE

A. General:

1. Type: Molded case.
2. Trip Ratings: 15 amps to 800 amps.
3. Voltage Ratings: 120V ac, 240V ac, 277V ac, 480V ac, and 600V ac.
4. Suitable for mounting and operating in any position.
5. UL 489.
6. 80 percent rated.
7. Not identified with Line or Load (capable of backfeed).

B. Operating Mechanism:

1. Overcenter, trip-free, toggle type handle.
2. Quick-make, quick-break action.
3. Locking provisions for padlocking breaker in OPEN position.
4. ON/OFF and TRIPPED indicating positions of operating handle.
5. Operating handle to assume a CENTER position when tripped.

C. Trip Mechanism:

1. Individual permanent thermal and magnetic trip elements in each pole.
2. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
3. Long time and short time adjustment for frames 400 Amps and greater.
4. Two and three pole, common trip.
5. Automatically opens all poles when overcurrent occurs on one pole.
6. Test button on cover.
7. Calibrated for 40 degrees C ambient, unless shown otherwise.
8. Do not provide single-pole circuit breakers with handle ties where multi-pole circuit breakers are shown.

D. Short Circuit Interrupting Ratings: Equal to rating of existing equipment.

E. Accessories: Shunt trip, bell alarms, auxiliary switches, handle lock ON devices, mechanical interlocks, key interlocks, unit mounting bases, double lugs as shown or otherwise required. Shunt trip operators shall be continuous duty rated or have coil-clearing contacts.

GRFF OZONE SYSTEM REPLACEMENT

F. Connections:

1. Supply (line side) at either end.
2. Mechanical wire lugs, except crimp compression lugs where shown.
3. Lugs removable/replaceable for breaker frames greater than 100 amperes.
4. Suitable for 75 degrees C rated conductors without derating breaker or conductor ampacity.
5. Use bolted bus connections, except where bolt-on is not compatible with existing breaker provisions.

G. Enclosures for Independent Mounting:

1. See Article Enclosures.
2. Service Entrance Use: Breakers in required enclosure and required accessories shall be UL 489 listed.
3. Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position. Provide bypass feature for use by qualified personnel.
4. Lockable in the off position.

2.02 FUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

A. UL 98 listed for use and location of installation.

B. NEMA KS 1.

C. Short Circuit Rating: 200,000 amps rms symmetrical with Class R, Class J, or Class L fuses installed.

D. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.

E. Connections:

1. Mechanical lugs, except crimp compression lugs where shown.
2. Lugs removable/replaceable.
3. Suitable for 75 degrees C rated conductors at NEC 75 degrees C ampacity.

F. Fuse Provisions:

1. 30-amp to 600-amp rated shall incorporate rejection feature to reject all fuses except Class R.

2. 601-amp rated and greater shall accept Class L fuses, unless otherwise shown.
3. Control fuse holders to have blown fuse indicator.

G. Enclosures: See Article Enclosures.

H. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.

I. Lockable in the off position.

2.03 NONFUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

A. NEMA KS 1.

B. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.

C. Lugs: Suitable for use with 75 degrees C wire at NEC 75 degrees C ampacity.

D. Enclosures: See Article Enclosures.

E. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.

F. Lockable in the off position

2.04 FUSE, 250-VOLT AND 600-VOLT

A. Power Distribution, General:

1. Current-limiting, with 200,000 ampere rms interrupting rating.
2. Provide to fit mountings specified with switches.
3. UL 248.

B. Power Distribution, Ampere Ratings 1-Amp to 600 Amps:

1. Class: RK-1.
2. Type: Dual element, with time delay.
3. Manufacturers and Products:
 - a. Bussmann; Types LPS-RK (600 volts) and Type LPN-RK (250 volts).
 - b. Littelfuse; Types LLS-RK (600 volts) and Type LLN-RK (250 volts).

GRFF OZONE SYSTEM REPLACEMENT

C. Power Distribution, Ampere Ratings 601 Amps to 6,000 Amps:

1. Class: L.
2. Double O-rings and silver links.
3. Manufacturers and Products:
 - a. Bussmann; Type KRP-C.
 - b. Littelfuse, Inc.; Type KLPC.

D. Cable Limiters:

1. 600V or less; crimp to copper cable, bolt to bus or terminal pad.
2. Manufacturer and Product: Bussmann; K Series.

E. Ferrule:

1. 600V or less, rated for applied voltage, small dimension.
2. Ampere Ratings: 1/10-amp to 30 amps.
3. Dual-element time-delay, time-delay, or nontime-delay, fast acting as required.
4. Provide with blocks or holders as indicated and suitable for location and use.
5. Manufacturers:
 - a. Bussmann.
 - b. Littlefuse, Inc.

2.05 SUPPORT AND FRAMING CHANNELS

A. Carbon Steel Framing Channel:

1. Material: Rolled, mild strip steel, 12-gauge minimum, ASTM A1011/A1011M, Grade 33.
2. Finish: Hot-dip galvanized after fabrication.

B. Paint Coated Framing Channel: Carbon steel framing channel with electro-deposited rust inhibiting acrylic or epoxy paint.

C. PVC-Coated Framing Channel: Carbon steel framing channel with 40-mil polyvinyl chloride coating.

D. Stainless Steel Framing Channel: Rolled, Type 316 stainless steel, 12-gauge minimum.

E. Extruded Aluminum Framing Channel:

1. Material: Extruded from Type 6063-T6 aluminum alloy.
2. Fittings fabricated from Alloy 5052-H32.

F. Nonmetallic Framing Channel:

1. Material: Fire retardant, fiber reinforced vinyl ester resin.
2. Channel fitting of same material as channel.
3. Nuts and bolts of long glass fiber reinforced polyurethane.

G. Manufacturers:

1. B-Line Systems, Inc.
2. Unistrut Corp.
3. Aickinstrut.

2.06 FIRESTOPS

A. General:

1. Provide UL 1479 classified hourly fire rating equal to, or greater than, the assembly penetrated.
2. Prevent the passage of cold smoke, toxic fumes, and water before and after exposure to flame.
3. Sealants and accessories shall have fire-resistance ratings as established by testing identical assemblies in accordance with ASTM E814, by UL, or other testing and inspection agency acceptable to authorities having jurisdiction.

2.07 ENCLOSURES

- A. Finish: Sheet metal structural and enclosure parts shall be completely painted using an electrodeposition process so interior and exterior surfaces as well as bolted structural joints have a complete finish coat on and between them.
- B. Color: Manufacturer's ANSI 61 standard color (gray) baked-on enamel, unless otherwise shown.
- C. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.

GRFF OZONE SYSTEM REPLACEMENT

D. Enclosure Selections:

1. Except as shown otherwise, provide electrical enclosures according to the following table:

Enclosures			
Location	Finish	Environment	NEMA 250 Type
Indoor	Finished	Dry	1
Indoor	Unfinished	Dry	1
Indoor	Unfinished	Industrial Use	12
Indoor and Outdoor	Any	Wet	4
Indoor and Outdoor	Any	Denoted "WP"	3R
Indoor and Outdoor	Any	Wet and Corrosive	4X 316 Stainless Steel
Indoor and Outdoor	Any	Wet, Dust or Oil	13
Indoor and Outdoor	Any	Hazardous Gas	7
Indoor and Outdoor	Any	Hazardous Dust	9

PART 3 EXECUTION

3.01 GENERAL

- A. Install equipment in accordance with manufacturer's recommendations.

3.02 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

- A. Install heavy-duty, oil-tight type in nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations, unless otherwise shown.
- B. Install heavy-duty, watertight and corrosion-resistant type in nonhazardous, outdoor, or normally wet areas, unless otherwise shown.

3.03 SUPPORT AND FRAMING CHANNEL

- A. Install where required for mounting and supporting electrical equipment, raceway, and cable tray systems.
- B. Channel Type:
 1. Interior, Wet or Dry (Noncorrosive) Locations:
 - a. Aluminum Raceway: Extruded aluminum or carbon steel with neoprene material isolators.

- b. PVC-Coated Conduit: PVC coated strut.
 - c. Steel Raceway and Other Systems Not Covered: Carbon steel or paint coated.
 - 2. Interior, Corrosive (Wet or Dry) Locations:
 - a. Aluminum Raceway: Extruded aluminum.
 - b. PVC Conduit: Type 316 stainless steel or nonmetallic strut.
 - c. PVC-Coated Steel Conduit and Other Systems Not Covered: Type 316 stainless steel, nonmetallic, or PVC-coated steel.
 - 3. Outdoor, Noncorrosive Locations:
 - a. Steel Raceway: Carbon steel or paint coated framing channel, except where mounted on aluminum handrail, then use aluminum framing channel.
 - b. Aluminum Raceway and Other Systems Not Covered: Aluminum framing channel or carbon steel with neoprene material isolators.
 - 4. Outdoor Corrosive Locations:
 - a. PVC Conduit: Type 316 stainless steel or nonmetallic.
 - b. Aluminum Raceway: Aluminum or carbon steel with neoprene material isolators.
 - c. PVC-Coated Steel Conduit and Other Systems Not Covered: Type 316 stainless steel, nonmetallic, or PVC-coated steel.
 - 5. Aluminum Railings: Devices mounted on aluminum railing shall use aluminum framing channel.
- C. Paint cut ends prior to installation with the following:
- 1. Carbon Steel Channel: Zinc-rich primer.
 - 2. Painted Channel: Rust-inhibiting epoxy or acrylic paint.
 - 3. Nonmetallic Channel: Epoxy resin sealer.
 - 4. PVC-Coated Channel: PVC patch.

3.04 FIRESTOPS

- A. Install in strict conformance with manufacturer's instructions. Comply with installation requirements established by testing and inspecting agency.
- B. Sealant: Install sealant including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide firestops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs.

END OF SECTION

**SECTION 26 05 05
CONDUCTORS****PART 1 GENERAL****1.01 REFERENCES**

A. The following is a list of standards which may be referenced in this section:

1. Association of Edison Illuminating Companies (AEIC): CS 8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 kV through 46 kV.
2. ASTM International (ASTM):
 - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. B3, Standard Specification for Soft or Annealed Copper Wire.
 - c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - d. B496, Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors.
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV Through 500 kV.
 - b. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
 - c. 404, Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2,500 V to 500,000 V.
4. Insulated Cable Engineer's Association, Inc. (ICEA):
 - a. S-58-679, Standard for Control Cable Conductor Identification.
 - b. S-73-532, Standard for Control Thermocouple Extensions and Instrumentation Cables.
 - c. T-29-520, Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input of 210,000 Btu/hour.
5. National Electrical Manufacturers' Association (NEMA):
 - a. CC 1, Electric Power Connectors for Substations.
 - b. WC 57, Standard for Control, Thermocouple Extension, and Instrumentation Cables.
 - c. WC 70, Standard for Power Cables Rated 2,000 Volts or Less for the Distribution of Electrical Energy.
 - d. WC 71, Standard for Nonshielded Cables Rated 2,001 Volts-5,000 Volts for Use in the Distribution of Electric Energy.

GRFF OZONE SYSTEM REPLACEMENT

- e. WC 74, 5 kV-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
- 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- 7. Telecommunications Industry Association (TIA): TIA-568-C, Commercial Building Telecommunications Cabling Standard.
- 8. UL:
 - a. 13, Standard for Safety for Power-Limited Circuit Cables.
 - b. 44, Standard for Safety for Thermoset-Insulated Wires and Cables.
 - c. 62, Standard for Safety for Flexible Cord and Cables.
 - d. 486A-486B, Standard for Safety for Wire Connectors.
 - e. 486C, Standard for Safety for Splicing Wire Connectors.
 - f. 510, Standard for Safety for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
 - g. 854, Standard for Safety for Service-Entrance Cables.
 - h. 1072, Standard for Safety for Medium-Voltage Power Cables.
 - i. 1277, Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
 - j. 1569, Standard for Safety for Metal-Clad Cables.
 - k. 1581, Standard for Safety for Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.02 SUBMITTALS

A. Action Submittals:

- 1. Product Data:
 - a. Wire and cable.
 - b. Wire and cable accessories.
 - c. Splice kits.
 - d. Tabulated testing results of all existing conductors subject to possible reuse. See section 26 08 00, Commissioning of Electrical Systems.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

- 1. Provide the Work in accordance with NFPA 70. Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.

2. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.
- B. Terminations and Splices for Conductors above 600 Volts: Work shall be done by journeyman lineman with splicing credentials or electrician certified to use materials approved for cable splices and terminations.

PART 2 PRODUCTS

2.01 CONDUCTORS 600 VOLTS AND BELOW

- A. Conform to applicable requirements of NEMA WC 70.
- B. Conductor Type:
 1. 120-Volt and 277-Volt Lighting, 10 AWG and Smaller: Solid copper.
 2. 120-Volt Receptacle Circuits, 10 AWG and Smaller: Solid copper.
 3. All Other Circuits: Stranded copper.
- C. Insulation: Type THHN/THWN-2, except for sizes No. 6 and larger, with XHHW-2 insulation.

2.02 CONDUCTORS ABOVE 600 VOLTS AS PROVIDED BY OZONE PSU MANUFACTURER

- A. EPR Insulated Cable:
 1. Extrusion: Single-pass, triple-tandem, of conductor screen, insulation, and insulation screen.
 2. Type: 5 nonshielded, UL 1072, Type MV-105.
 3. Conductors: Copper, Aluminum, concentric lay Class B round stranded in accordance with ASTM B3, ASTM B8, and ASTM B496.
 4. Conductor Screen: Extruded, semiconducting ethylene-propylene rubber in accordance with NEMA WC 71 and AEIC CS 8.
 5. Insulation: 133 percent insulation level, ethylene-propylene rubber (EPR) containing no polyethylene, in accordance with NEMA WC 71, and AEIC CS 8.
 6. Insulation Thickness: 115-mil, 5 kV, nominal.
 7. Insulation Screen: Thermosetting, semiconducting ethylene-propylene rubber (EPR), extruded directly over insulation in accordance with NEMA WC 74 and AEIC CS 8.
 8. Jacket: Extruded polyvinyl chloride (PVC) compound applied in accordance with NEMA WC 71 or NEMA WC 74.

GRFF OZONE SYSTEM REPLACEMENT

9. Operating Temperature: 105 degrees C continuous normal operations, 130 degrees C emergency operating conditions, and 250 degrees C short-circuit conditions.
10. Manufacturers:
 - a. Okonite Co.
 - b. Pirelli Wire and Cable.
 - c. General Cable.
 - d. Southwire Co.

2.03 600-VOLT RATED CABLE

A. General:

1. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 70,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Type 1, Multiconductor Control Cable:

1. Conductors:
 - a. 14 AWG, seven-strand copper.
 - b. Insulation: 15-mil PVC with 4-mil nylon.
 - c. UL 1581 listed as Type THHN/THWN rated VW-1.
 - d. Conductor group bound with spiral wrap of barrier tape.
 - e. Color Code: In accordance with ICEA S-58-679, Method 1, Table 2.
2. Cable: Passes the ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.

3. Cable Sizes:

No. of Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
3	0.41	45
5	0.48	45
7	0.52	45
12	0.72	60
19	0.83	60
25	1.00	60
37	1.15	80

4. Manufacturers:

- a. Okonite Co.
- b. Southwire.

C. Type 2, Multiconductor Power Cable:

1. General:

- a. Meet or exceed UL 1581 for cable tray use.
- b. Meet or exceed UL 1277 for direct burial and sunlight-resistance.
- c. Overall Jacket: PVC.

2. Conductors:

- a. Class B stranded, coated copper.
- b. Insulation: Chemically cross-linked ethylene-propylene or cross-linked polyethylene.
- c. UL rated VW-1 or listed Type XHHW-2.
- d. Color Code:
 - 1) Conductors, size 8 AWG and smaller, colored conductors, ICEA S-58-679, Method 1, Table 1.
 - 2) Conductors, size 6 AWG and larger, ICEA S-73-532, Method 4.

3. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.

GRFF OZONE SYSTEM REPLACEMENT

4. Cable Sizes:

Conductor Size	Minimum Ground Wire Size	No. of Current Carrying Conductors	Max. Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
12	12	2 3 4	0.42 0.45 0.49	45
10	10	2 3 4	0.54 0.58 0.63	60
8	10	3 4	0.66 0.75	60
6	8	3 4	0.74 0.88	60
4	6	3 4	0.88 1.04	60 80
2	6	3 4	1.01 1.16	80
1	6	3 4	1.10 1.25	80
1/0	6	3 4	1.22 1.35	80
2/0	4	3 4	1.32 1.53	80
3/0	4	3 4	1.40 1.60	80
4/0	4	3 4	1.56 1.78	80 110

5. Manufacturers:
- Okonite Co.
 - Southwire.

D. Type 3, 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.

1. Outer Jacket: 45-mil nominal thickness.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
3. Dimension: 0.31-inch nominal OD.
4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 - b. 20 AWG, seven-strand tinned copper drain wire.
 - c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nominal nylon.
 - e. Color Code: Pair conductors, black and red.
5. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.

E. Type 4, 16 AWG, Twisted, Shielded Triad Instrumentation Cable: Single triad, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.

1. Outer Jacket: 45-mil nominal.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
3. Dimension: 0.32-inch nominal OD.
4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 - b. 20 AWG, seven-strand, tinned copper drain wire.
 - c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nylon.
 - e. Color Code: Triad conductors black, red, and blue.
5. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.

GRFF OZONE SYSTEM REPLACEMENT

- F. Type 5, 18 AWG, Multitwisted Shielded Pairs, with a Common Overall Shield, Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable, meeting NEMA WC 57 requirements.

1. Conductors:

- a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8.
- b. Tinned copper drain wires.
- c. Pair drain wire size AWG 20, group drain wire size AWG 18.
- d. Insulation: 15-mil PVC.
- e. Jacket: 4-mil nylon.
- f. Color Code: Pair conductors, black and red with red conductor numerically printed for group identification.
- g. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer.

2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

3. Cable Sizes:

Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
1	.28	45
3	.28	45
4	0.50	45
6	.56	60
8	0.68	60
12	0.82	60
16	0.95	80
24	1.16	80
36	1.33	80
50	1.56	80

4. Manufacturers:

- a. Okonite Co.
- b. Alpha Wire Corp.
- c. Belden.

- G. Type 6, 18 AWG, Multitwisted Pairs with Common Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable meeting NEMA WC 57.

GRFF OZONE SYSTEM REPLACEMENT

1. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8.
 - b. Tinned copper drain wire size AWG 18.
 - c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nylon.
 - e. Color Code: Pair conductors, black and red with red conductor numerically printed for group identification.
2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

Cable Sizes: Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
1	.28	45
3	.28	45
4	0.48	45
6	.56	60
8	0.63	60
12	0.75	60
16	0.83	60
24	1.10	80
36	1.21	80
50	1.50	80

3. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.

H. Type 8, Multiconductor Adjustable Frequency Drive Power Cable:

1. Conductors:
 - a. Class B, stranded coated copper.
 - b. Insulation: 600-volt cross-linked polyethylene, UL Type XHHW-2.
 - c. Grounding Conductors: Insulated stranded copper.
2. Sheath:
 - a. UL 1277 Type TC, 90 degrees C.
 - b. Continuous shield, A1/polyester foil, drain wires, overall copper braid.

GRFF OZONE SYSTEM REPLACEMENT

3. Outer Jacket: Polyvinyl chloride (PVC) per UL 1569.
4. Cable Sizes:

Conductor Size	Minimum Ground Wire Size (AWG)	No. of Insulated Conductors	Max. Outside Diameter (Inches)	Minimum Jacket Thickness (Mils)
12 AWG	12	4	0.655	50
10 AWG	10	4	0.769	50
8 AWG	8	4	0.940	50
6 AWG	6	4	1.038	50
4 AWG	4	4	1.180	50
2 AWG	2	4	1.351	50

5. Manufacturers and Products:
 - a. Alpha Wire; Series V.
 - b. Belden; Series 29500.
 - c. LAPP USA; OLFLEX VFD Slim.

2.04 SPECIAL CABLES

A. Type 31, Data Highway Cable Allen-Bradley “Blue Hose:”

1. Meet or exceed electrical characteristics of Allen-Bradley Catalog No. 1770-CD.
2. Approved by Allen-Bradley for use with A-B programmable logic controller systems.
3. Outer Jacket: Blue PVC.
4. Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
5. Drain: 55 percent tinned copper braid and drain wire.
6. Dimension: 0.243-inch nominal OD.
7. Conductors:
 - a. One pair 20 AWG, seven-strand tinned copper.
 - b. Insulation: Polyethylene.
 - c. Color Code: Blue and clear.
8. Manufacturers:
 - a. Allen-Bradley.
 - b. Belden.

- B. Type 32, DeviceNet Round Cable, 600V, Class 1, Two Twisted, Shielded Pairs with Common Overall Shield:
 - 1. Outer Jacket: PVC.
 - 2. Overall Shield: Tinned copper braid, 18 AWG tinned copper drain wire.
 - 3. Individual Pair Shield: Aluminum foil-polyester tape.
 - 4. Dimension: 0.460-inch nominal OD.
 - 5. Conductors:
 - a. 15 AWG stranded tinned copper.
 - b. Insulation: FEP.
 - 6. Manufacturer and Product: Belden; 7897A.
- C. Type 33, DeviceNet Flat Cable, 600V, Class 1, Four Conductor Unshielded Network Trunk Cable:
 - 1. Outer Jacket: Thermoplastic Elastomer (TPE).
 - 2. Conductors: Four conductor, unshielded, flat configuration.
 - 3. Manufacturer and Product: Allen-Bradley; 1485C-P1E.
- D. Type 34, Profibus PA Cable, 300V:
 - 1. Outer Jacket: PVC.
 - 2. Shield: Aluminum foil-polyester tape, 20 AWG tinned copper drain wire.
 - 3. Dimension: 0.253-inch nominal OD.
 - 4. Conductors:
 - a. 18 AWG stranded tinned copper.
 - b. Insulation: polyolefin.
 - 5. Manufacturer and Product: Belden; 3076F.

2.05 GROUNDING CONDUCTORS

- A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE, XHHW, or THHN/THWN, insulation.
- B. Direct Buried: Bare stranded copper.

2.06 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

- A. Tape:
 - 1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
 - 2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.

GRFF OZONE SYSTEM REPLACEMENT

3. Arc and Fireproofing:
 - a. 30-mil, elastomer.
 - b. Manufacturers and Products:
 - 1) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
 - 2) Plymouth; 53 Plyarc, with 77 Plyglas glass cloth tapebinder.

B. Identification Devices:

1. Sleeve:
 - a. Permanent, PVC, yellow or white, with legible machine-printed black markings.
 - b. Manufacturers and Products:
 - 1) Raychem; Type D-SCE or Type ZH-SCE.
 - 2) Brady, Type 3PS.
2. Heat Bond Marker:
 - a. Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive.
 - b. Self-laminating protective shield over text.
 - c. Machine printed black text.
 - d. Manufacturer and Product: 3M Co.; Type SCS-HB.
3. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
4. Tie-On Cable Marker Tags:
 - a. Chemical-resistant white tag.
 - b. Size: 1/2-inch by 2 inches.
 - c. Manufacturer and Product: Raychem; Type CM-SCE.
5. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.

C. Connectors and Terminations:

1. Nylon, Self-Insulated Crimp Connectors:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulug.
 - 3) ILSCO.
2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Seamless.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulink.
 - 3) ILSCO; ILSCONS.

3. Self-Insulated, Freespring Wire Connector (Wire Nuts):
 - a. UL 486C.
 - b. Plated steel, square wire springs.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts.
 - 2) Ideal; Twister.
4. Self-Insulated, Set Screw Wire Connector:
 - a. Two piece compression type with set screw in brass barrel.
 - b. Insulated by insulator cap screwed over brass barrel.
 - c. Manufacturers:
 - 1) 3M Co.
 - 2) Thomas & Betts.
 - 3) Marrette.

D. Cable Lugs:

1. In accordance with NEMA CC 1.
2. Rated 600 volts of same material as conductor metal.
3. Uninsulated Crimp Connectors and Terminators:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Manufacturers and Products:
 - 1) Thomas & Betts; Color-Keyed.
 - 2) Burndy; Hydent.
 - 3) ILSCO.
4. Uninsulated, Bolted, Two-Way Connectors and Terminators:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Locktite.
 - 2) Burndy; Quiklug.
 - 3) ILSCO.

E. Cable Ties:

1. Nylon, adjustable, self-locking, and reusable.
2. Manufacturer and Product: Thomas & Betts; TY-RAP.

F. Heat Shrinkable Insulation:

1. Thermally stabilized cross-linked polyolefin.
2. Single wall for insulation and strain relief.
3. Dual Wall, adhesive sealant lined, for sealing and corrosion resistance.
4. Manufacturers and Products:
 - a. Thomas & Betts; SHRINK-KON.
 - b. Raychem; RNF-100 and ES-2000.

GRFF OZONE SYSTEM REPLACEMENT

- G. Data Cable Accessories: Terminators, connectors, and junctions necessary for a complete Profinet system.

2.07 SOURCE QUALITY CONTROL

- A. Conductors 600 Volts and Below: Test in accordance with UL 44 and UL 854.
- B. Conductors Above 600 Volts: Test in accordance with NEMA WC 71 and AEIC CS 8 partial discharge level test for EPR insulated cable.

PART 3 EXECUTION

3.01 GENERAL

- A. Conductor installation shall be in accordance with manufacturer's recommendations.
- B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.
- C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
- D. Terminate conductors and cables, unless otherwise indicated.
- E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors.
- F. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.
- G. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.
- H. Concrete-Encased Raceway Installation: Prior to installation of conductors, pull through each raceway a mandrel approximately 1/4 inch smaller than raceway inside diameter.
- I. See specification Section 26 08 00, Commissioning of Electrical Systems for testing existing power and control conductors prior to reuse.

3.02 POWER CONDUCTOR COLOR CODING

A. Conductors 600 Volts and Below:

1. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering area 1-1/2 inches to 2 inches wide.
2. 8 AWG and Smaller: Provide colored conductors.
3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts, Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts, Three-Phase, Four-Wire, Delta, Center Tap, Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	Grey Brown Orange Yellow
Note: Phase A, B, C implies direction of positive phase rotation.		

4. Tracer: Outer covering of white with identifiable colored strip, other than green, in accordance with NFPA 70.

3.03 CIRCUIT IDENTIFICATION

- A. Identify power, instrumentation, and control conductor circuits at each termination, and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.
- B. Circuits Appearing in Circuit Schedules: Identify using circuit schedule designations.

GRFF OZONE SYSTEM REPLACEMENT

C. Circuits Not Appearing in Circuit Schedules:

1. Assign circuit name based on device or equipment at load end of circuit.
2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.

D. Method:

1. Conductors 3 AWG and Smaller: Identify with sleeves or heat bond markers.
2. Cables and Conductors 2 AWG and Larger:
 - a. Identify with marker plates or tie-on cable marker tags.
 - b. Attach with nylon tie cord.
3. Taped-on markers or tags relying on adhesives not permitted.

3.04 CONDUCTORS 600 VOLTS AND BELOW

- A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.
- B. Do not splice incoming service conductors and branch power distribution conductors 6 AWG and larger, unless specifically indicated or approved by Engineer.

C. Connections and Terminations:

1. Install wire nuts only on solid conductors. Wire nuts are not allowed on stranded conductors.
2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control, circuit conductors.
3. Install self-insulated, set screw wire connectors for two-way connection of power circuit conductors 12 AWG and smaller.
4. Install uninsulated crimp connectors and terminators for power circuit conductors 4 AWG through 2/0 AWG.
5. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors 3/0 AWG and larger.
6. Install uninsulated terminators bolted together on motor circuit conductors 10 AWG and larger.
7. Place no more than one conductor in any single-barrel pressure connection.
8. Install crimp connectors with tools approved by connector manufacturer.
9. Install terminals and connectors acceptable for type of material used.

10. Compression Lugs:
 - a. Attach with a tool specifically designed for purpose. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
 - b. Do not use plier type crimpers.
 - c. Long barrel type for double crimp.
- D. Do not use soldered mechanical joints.
- E. Splices and Terminations:
 1. Only allowed with prior approval from Engineer and Owner.
 2. Insulate uninsulated connections.
 3. Indoors: NEMA 1 box with power distribution block.
 4. Below Grade and Wet or Damp Locations: NEMA 3R box with power distribution block.
- F. Cap spare conductors with UL listed end caps.
- G. Cabinets, Panels, and Motor Control Centers:
 1. Remove surplus wire, bridle and secure.
 2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.
- H. Control and Instrumentation Wiring:
 1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.
 2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
 3. No splicing of control wiring allowed.
- I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

3.05 CONDUCTORS ABOVE 600 VOLTS

- A. Do not splice unless specifically indicated or approved by Engineer.

GRFF OZONE SYSTEM REPLACEMENT

- B. Single Conductor Cable Terminations: Provide heat shrinkable stress control and outer nontracking insulation tubings, high relative permittivity stress relief mastic for insulation shield cutback treatment, and a heat-activated sealant for environmental sealing.
- C. Install terminals or connectors acceptable for type of conductor material used.
- D. Provide shield termination and grounding for terminations.
- E. Provide necessary mounting hardware, covers, and connectors.
- F. Connections and Terminations:
 - 1. Install uninsulated crimp connectors and terminators for power circuit conductors 4 AWG and larger.
 - 2. Install uninsulated, bolted, two-way connectors for motor circuit conductors No. 12 and larger.
 - 3. Insulate bus connections with heat shrinking tubing, tape, and sheets.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers (IEEE): C2, National Electrical Safety Code (NESC).
2. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC).
3. UL 467.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Product data for the following:
 - 1) Mechanical connectors.
 - 2) Compression connectors.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, provide material and equipment labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ to provide a basis for approval under NEC.
2. Materials and equipment manufactured within scope of standards published by UL:
 - a. Confirm conformance with UL standards.
 - b. Supply with an applied UL listing mark.

GRFF OZONE SYSTEM REPLACEMENT

PART 2 PRODUCTS

2.01 GROUND CONDUCTORS

- A. As specified in Section 26 05 05, Conductors.

2.02 CONNECTORS

- A. Compression Type:
 - 1. Compress-deforming irreversible type; wrought copper extrusion material.
 - 2. Single indentation for conductors 6 AWG and smaller.
 - 3. Double indentation with extended barrel for conductors 4 AWG and larger.
 - 4. Barrels prefilled with oxide-inhibiting and anti-seizing compound and sealed.
 - 5. Manufacturers and Products:
 - a. Burndy Corp.; Hyground Compression.
 - b. Thomas and Betts Co.; EZGround Compression.
 - c. NVent ILSCO.
- B. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.
 - 1. Manufacturers:
 - a. Burndy Corp.
 - b. Thomas and Betts Co.
 - c. O-Z Gedney.

PART 3 EXECUTION

3.01 GENERAL

- A. Provide Grounding in compliance with NFPA 70 and IEEE C2.
- B. Bond together exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.
- C. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.

D. Shielded Instrumentation Cables:

1. Ground shield to ground bus at power supply for analog signal.
2. Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.
3. Do not ground instrumentation cable shield at more than one point.

3.02 WIRE CONNECTIONS

- A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.
- B. Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.
- C. Connect ground conductors to raceway grounding bushings.
- D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.
- E. Connect enclosure of equipment containing ground bus to that bus.
- F. Bolt connections to equipment ground bus.
- G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.
- H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.
- I. Metallic Equipment Enclosures: Use furnished ground lug; if none furnished, tap equipment housing and install solderless terminal connected to box with machine screw. For circuits greater than 20 amps use minimum 5/16-inch diameter bolt.

3.03 MOTOR GROUNDING

- A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.
- B. Nonmetallic Raceways and Flexible Tubing: Install an equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.
- C. Motors Less Than 10 hp: Use furnished ground lug in motor connection box. If none furnished, provide compression, spade-type terminal connected to conduit box mounting screw.

GRFF OZONE SYSTEM REPLACEMENT

- D. Motors 10 hp and Above: Use furnished ground lug in motor connection box. If none furnished, tap motor frame or equipment housing; furnish compression, one-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.

3.04 CONNECTIONS

A. General:

- 1. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.

B. Compression Type:

- 1. Install in accordance with connector manufacturer's recommendations.
- 2. Install connectors of proper size for grounding conductors and ground rods specified.
- 3. Install using connector manufacturer's compression tool having proper sized dies and operate per manufacturer's instructions.

C. Mechanical Type:

- 1. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.
- 2. Install in accordance with connector manufacturer's recommendations.
- 3. Do not conceal mechanical connections.

3.05 METAL STRUCTURE GROUNDING

- A. Bond metal sheathing and exposed metal vertical structural elements to grounding system.
- B. Bond electrical equipment supported by metal platforms to the platforms.
- C. Provide grounding conductor between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

END OF SECTION

**SECTION 26 05 33
RACEWAY AND BOXES**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Association of State Highway and Transportation Officials (AASHTO): HB, Standard Specifications for Highway Bridges.
 2. ASTM International (ASTM):
 - a. A123/123M, Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
 - b. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - c. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - d. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 - e. D149, Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
 3. Telecommunications Industry Association (TIA): 569B, Commercial Building Standard for Telecommunications Pathways and Spaces.
 4. National Electrical Contractor's Association, Inc. (NECA): Installation standards.
 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. C80.1, Electrical Rigid Steel Conduit (ERSC).
 - c. C80.3, Steel Electrical Metallic Tubing (EMT).
 - d. C80.5, Electrical Rigid Aluminum Conduit (ERAC).
 - e. C80.6, Electrical Intermediate Metal Conduit (EIMC).
 - f. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - g. TC 2, Electrical Polyvinyl Chloride (PVC) Conduit.
 - h. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
 - i. TC 6, Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation.

GRFF OZONE SYSTEM REPLACEMENT

- j. TC 14, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
- k. VE 1, Metallic Cable Tray Systems.
- 6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
- 7. UL:
 - a. 1, Standard for Safety for Flexible Metal Conduit.
 - b. 5, Standard for Safety for Surface Metal Raceways and Fittings.
 - c. 6, Standard for Safety for Electrical Rigid Metal Conduit – Steel.
 - d. 6A, Standard for Safety for Electrical Rigid Metal Conduit – Aluminum, Red Brass and Stainless.
 - e. 360, Standard for Safety for Liquid-Tight Flexible Steel Conduit.
 - f. 514B, Standard for Safety for Conduit, Tubing, and Cable Fittings.
 - g. 651, Standard for Safety for Schedule 40 and Schedule 80 Rigid PVC Conduit and Fittings.
 - h. 651A, Standard for Safety for Type EB and Type A Rigid PVC Conduit and HDPE Conduit.
 - i. 797, Standard for Safety for Electrical Metallic Tubing – Steel.
 - j. 870, Standard for Safety for Wireways, Auxiliary Gutters, and Associated Fittings.
 - k. 1242, Standard for Safety for Electrical Intermediate Metal Conduit – Steel.
 - l. 1660, Standard for Safety for Liquid-Tight Flexible Nonmetallic Conduit.
 - m. 1684, Standard for Safety for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
 - n. 2024, Standard for Safety for Optical Fiber and Communication Cable Raceway.

1.02 SUBMITTALS

A. Action Submittals:

- 1. Manufacturer's Literature:
 - a. Rigid galvanized steel conduit.
 - b. PVC-coated rigid galvanized steel.
 - c. Flexible metal, liquid-tight conduit.
 - d. Conduit fittings.
 - e. Junction boxes.
 - f. Accessories.
- 2. Method for bending PVC conduit less than 30 degrees.
- 3. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

B. PVC-Coated, Rigid Galvanized Steel Conduit Installer: Certified by conduit manufacturer as having received minimum 2 hours of training on installation procedures.

PART 2 PRODUCTS

2.01 CONDUIT AND TUBING

A. Rigid Galvanized Steel Conduit (RGS):

1. Meet requirements of NEMA C80.1 and UL 6.
2. Material: Hot-dip galvanized with chromated protective layer.
3. Meet requirements of NEMA TC 2 and UL 651.
4. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.

B. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of NEMA RN 1.
2. Material:
 - a. Meet requirements of NEMA C80.1 and UL 6.
 - b. Exterior Finish: PVC coating, 40-mil nominal thickness; bond to metal shall have tensile strength greater than PVC.
 - c. Interior finish: Urethane coating, 2-mil nominal thickness.
3. Threads: Hot-dipped galvanized and factory coated with urethane.
4. Bendable without damage to interior or exterior coating.

C. Flexible Metal, Liquid-Tight Conduit:

1. UL 360 listed for 105 degrees C insulated conductors.
2. Material: Galvanized steel with extruded PVC jacket.

GRFF OZONE SYSTEM REPLACEMENT

2.02 FITTINGS

A. Rigid Galvanized Steel and Intermediate Metal Conduit:

1. General:
 - a. Meet requirements of UL 514B.
 - b. Type: Threaded, galvanized. Set screw and threadless compression fittings not permitted.
2. Bushing:
 - a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C.
 - b. Manufacturers and Products:
 - 1) Appleton; Series BU-I.
 - 2) O-Z/Gedney; Type HB.
3. Grounding Bushing:
 - a. Material: Malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.
 - b. Manufacturers and Products:
 - 1) Appleton; Series GIB.
 - 2) O-Z/Gedney; Type HBLG.
4. Conduit Hub:
 - a. Material: Malleable iron with insulated throat with bonding screw.
 - b. UL listed for use in wet locations.
 - c. Manufacturers and Products:
 - 1) Appleton, Series HUB-B.
 - 2) O-Z/Gedney; Series CH.
 - 3) Meyers; ST Series.
5. Conduit Bodies:
 - a. Sized as required by NFPA 70.
 - b. Manufacturers and Products (For Normal Conditions):
 - 1) Appleton; Form 35 threaded unilets.
 - 2) Crouse-Hinds; Form 7 or Form 8 threaded condulets.
 - 3) Killark; Series O electrolets.
 - 4) Thomas & Betts; Form 7 or Form 8.
 - c. Manufacturers (For Hazardous Locations):
 - 1) Appleton.
 - 2) Crouse-Hinds.
 - 3) Killark.
6. Couplings: As supplied by conduit manufacturer.
7. Unions:
 - a. Concrete tight, hot-dip galvanized malleable iron.
 - b. Manufacturers and Products:
 - 1) Appleton; Series SCC bolt-on coupling or Series EC three-piece union.

- 2) O-Z/Gedney; Type SSP split coupling or Type 4 Series, three-piece coupling.
 8. Conduit Sealing Fitting:
 - a. Manufacturers and Products:
 - 1) Appleton; Type EYF, Type EYM, or Type ESU.
 - 2) Crouse-Hinds; Type EYS or Type EZS.
 - 3) Killark; Type EY or Type EYS.
 9. Drain Seal:
 - a. Manufacturers and Products:
 - 1) Appleton; Type EYD.
 - 2) Crouse-Hinds; Type EYD or Type EZD.
 10. Drain/Breather Fitting:
 - a. Manufacturers and Products:
 - 1) Appleton; Type ECDB.
 - 2) Crouse-Hinds; ECD.
 11. Expansion Fitting:
 - a. Manufacturers and Products:
 - 1) Deflection/Expansion Movement:
 - a) Appleton; Type DF.
 - b) Crouse-Hinds; Type XD.
 - 2) Expansion Movement Only:
 - a) Appleton; Type XJ.
 - b) Crouse-Hinds; Type XJ.
 - c) Thomas & Betts; XJG-TP.
 12. Cable Sealing Fitting:
 - a. To form watertight nonslip cord or cable connection to conduit.
 - b. For Conductors with OD of 1/2-inch or Less: Neoprene bushing at connector entry.
 - c. Manufacturers and Products:
 - 1) Appleton; CG-S.
 - 2) Crouse-Hinds; CGBS.
- B. PVC Conduit and Tubing:
1. Meet requirements of NEMA TC 3.
 2. Type: PVC, slip-on.
- C. PVC-Coated Rigid Galvanized Steel Conduit:
1. Meet requirements of UL 514B.
 2. Fittings: Rigid galvanized steel type, PVC coated by conduit manufacturer.
 3. Conduit Bodies: Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC coated by conduit manufacturer.

GRFF OZONE SYSTEM REPLACEMENT

4. Finish: 40-mil PVC exterior, 2-mil urethane interior.
5. Overlapping pressure-sealing sleeves.
6. Conduit Hangers, Attachments, and Accessories: PVC-coated.
7. Manufacturers:
 - a. Robroy Industries.
 - b. Ocal.
8. Expansion Fitting:
 - a. Manufacturer and Product: Ocal; OCAL-BLUE XJG.

D. Flexible Metal, Liquid-Tight Conduit:

1. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
2. Insulated throat and sealing O-rings.
3. Manufacturers and Products:
 - a. Thomas & Betts; Series 5331.
 - b. O-Z/Gedney; Series 4Q.

2.03 JUNCTION AND PULL BOXES

A. Conduit Bodies Used as Junction Boxes: As specified under Article Fittings.

B. Large Sheet Steel Box:

1. NEMA 250, Type 1.
2. Box: Code-gauge, galvanized steel.
3. Cover: Full access, screw type.
4. Machine Screws: Corrosion-resistant.

2.04 ACCESSORIES

A. Identification Devices:

1. Raceway Tags:
 - a. Material: Permanent, nonferrous metal.
 - b. Shape: Round.
 - c. Raceway Designation: Pressure stamped, embossed, or engraved.
 - d. Tags relying on adhesives or taped-on markers not permitted.

B. Raceway Coating: Clean and paint in accordance with Supplier's Instructions.

C. Heat Shrinkable Tubing:

1. Material: Heat-shrinkable, cross-linked polyolefin.
2. Semi-flexible with meltable adhesive inner liner.
3. Color: Black.

- 4. Manufacturers:
 - a. Raychem.
 - b. 3M.
- D. Wraparound Duct Band:
 - 1. Material: Heat-shrinkable, cross-linked polyolefin, precoated with hot-melt adhesive.
 - 2. Width: 50 mm minimum.
 - 3. Manufacturer and Product: Raychem; Type TWDB.

PART 3 EXECUTION

3.01 GENERAL

- A. Conduit and tubing sizes shown are based on use of copper conductors. Reference Section 26 05 05, Conductors, concerning conduit sizing for aluminum conductors.
- B. Comply with NECA Installation Standards.
- C. Crushed or deformed raceways not permitted.
- D. Maintain raceway entirely free of obstructions and moisture.
- E. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.
- F. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.
- G. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.
- H. Group raceways installed in same area.
- I. Proximity to Heated Piping: Install raceways minimum 12 inches from parallel runs.
- J. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.
- K. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.
- L. Block Walls: Do not install raceways in same horizontal course or vertical cell with reinforcing steel.

GRFF OZONE SYSTEM REPLACEMENT

- M. Install watertight fittings in outdoor, underground, or wet locations.
- N. Paint threads and cut ends, before assembly of fittings, galvanized conduit, or PVC-coated galvanized conduit installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.
- O. Metal conduit shall be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.
- P. Do not install raceways in concrete equipment pads, foundations, or beams without Engineer approval.
- Q. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.
- R. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.
- S. Install conduits for fiber optic cables, telephone cables, and Category 6 data cables in strict conformance with the requirements of TIA 569B.

3.02 REUSE OF EXISTING CONDUITS

- A. Where the Drawings indicate existing conduits may be reused, they may be reused only where they meet the following criteria.
 - 1. Conduit is in useable condition with no deformation, corrosion, or damage to exterior surface.
 - 2. Conduit is sized per the NEC.
 - 3. Conduit is of the type specified in Contract Documents.
 - 4. Conduit is supported as specified in Contract Documents.
- B. Conduit shall be reamed with wire brush, then with a mandrel approximately 1/4-inch smaller than raceway inside diameter then cleaned prior to pulling new conductors.
- C. Conduits made spare by demolition shall have a pull-string installed for future use.

3.03 CONDUIT APPLICATION

- A. Diameter: Minimum 3/4-inch.
- B. Exterior, Exposed:
 - 1. Rigid galvanized steel.
 - 2. PVC-coated rigid galvanized steel.

C. Interior, Exposed:

1. Rigid galvanized steel.
2. PVC-coated rigid galvanized steel.

3.04 FLEXIBLE CONNECTIONS

A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other locations approved by Engineer where flexible connection is required to minimize vibration:

1. Conduit Size 4 Inches or Less: Flexible, liquid-tight conduit.
2. Conduit Size Over 4 Inches: Nonflexible.
3. Wet or Corrosive Areas: Flexible metal liquid-tight.
4. Dry Areas: Flexible, metallic liquid-tight.
5. Hazardous Areas: Flexible coupling suitable for Class I, Division 1 and 2 areas.

B. Suspended Lighting Fixtures in Dry Areas: Flexible steel, nonliquid-tight conduit.

C. Outdoor Areas, Process Areas Exposed to Moisture, and Areas Required to be Oiltight and Dust-Tight: Flexible metal, liquid-tight conduit.

D. Flexible Conduit Length: 18 inches minimum, 60 inches maximum; sufficient to allow movement or adjustment of equipment.

3.05 PENETRATIONS

A. Make at right angles, unless otherwise shown.

B. Notching or penetration of structural members, including footings and beams, not permitted.

C. Fire-Rated Walls, Floors, or Ceilings: Firestop openings around penetrations to maintain fire-resistance rating using fire penetration seal as specified in Section 26 05 04, Basic Electrical Materials and Methods.

D. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack, or use watertight seal device.

E. Entering Structures:

1. General: Seal raceway at first box or outlet with oakum or expandable plastic compound to prevent entrance of gases or liquids from one area to another.

GRFF OZONE SYSTEM REPLACEMENT

2. Concrete Roof or Membrane Waterproofed Wall or Floor:
 - a. Provide a watertight seal.
 - b. Without Concrete Encasement: Install watertight entrance seal device on each side.
 - c. With Concrete Encasement: Install watertight entrance seal device on accessible side.
 - d. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
 - e. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.

3.06 SUPPORT

- A. Support from structural members only, at intervals not exceeding NFPA 70 requirements. Do not exceed 10 feet in any application. Do not support from piping, pipe supports, or other raceways.
- B. Multiple Adjacent Raceways: Provide ceiling trapeze. For trapeze-supported conduit, allow 20 percent extra space for future conduit.
- C. Application/Type of Conduit Strap:
 1. Rigid Steel Conduit: Zinc-coated steel, pregalvanized steel or malleable iron.
 2. PVC-Coated Rigid Steel Conduit: PVC-coated metal.
 3. Nonmetallic Conduit: Nonmetallic or PVC-coated metal.
- D. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:
 1. Wood: Wood screws.
 2. Hollow Masonry Units: Toggle bolts.
 3. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
 4. Steelwork: Machine screws.
 5. Location/Type of Hardware:
 - a. Dry, Noncorrosive Areas: Galvanized.
 - b. Wet, Noncorrosive Areas: Stainless steel.
 - c. Corrosive Areas: Stainless steel.
- E. Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

3.07 BENDS

- A. Install concealed raceways with a minimum of bends in the shortest practical distance.
- B. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than 20 times cable diameter, 15 inches minimum.
- C. Install with symmetrical bends or cast metal fittings.
- D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.
- E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.
- F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.
- G. PVC Conduit:
 - 1. Bends 30 Degrees and Larger: Provide factory-made elbows.
 - 2. 90-Degree Bends: Provide rigid steel elbows, PVC-coated where direct buried.
 - 3. Use manufacturer's recommended method for forming smaller bends.
- H. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

3.08 PVC-COATED RIGID STEEL

- A. Install in accordance with manufacturer's instructions.
- B. Tools and equipment used in cutting, bending, threading and installation of PVC-coated rigid conduit shall be designed to limit damage to PVC coating.
- C. Provide PVC boot to cover exposed threading.

3.09 TERMINATION AT ENCLOSURES

- A. Cast Metal Enclosure: Install manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.

GRFF OZONE SYSTEM REPLACEMENT

B. Nonmetallic, Cabinets, and Enclosures:

1. Terminate conduit in threaded conduit hubs, maintaining enclosure integrity.
2. Metallic Conduit: Provide ground terminal for connection to maintain continuity of ground system.

C. Sheet Metal Boxes, Cabinets, and Enclosures:

1. General:
 - a. Install insulated bushing on ends of conduit where grounding is not required.
 - b. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
 - c. Utilize sealing locknuts or threaded hubs on sides and bottom of NEMA 3R and NEMA 12 enclosures.
 - d. Terminate conduits at threaded hubs at the tops of NEMA 3R and NEMA 12 boxes and enclosures.
 - e. Terminate conduits at threaded conduit hubs at NEMA 4 and NEMA 4X boxes and enclosures.
2. Rigid Galvanized Conduit:
 - a. Provide one lock nut each on inside and outside of enclosure.
 - b. Install grounding bushing at source enclosure.
 - c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad.
3. Flexible Metal Liquidtight Conduit: Provide two screw type, insulated, malleable iron connectors.
4. PVC-Coated Rigid Galvanized Steel Conduit: Provide PVC-coated, liquid-tight, metallic connector.
5. PVC Schedule 40 Conduit: Provide PVC terminal adapter with lock nut, except where threaded hubs required above.

D. Motor Control Center, Switchboard, and Free-Standing Enclosures:

1. Terminate metal conduit with grounding bushing; provide grounding jumper extending to equipment ground bus or grounding pad.
2. Terminate PVC conduit entering bottom with bell end fittings.

3.10 JUNCTION AND PULL BOXES

A. General:

1. Install plumb and level.
2. Installed boxes shall be accessible.
3. Do not install on finished surfaces.

4. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.
5. Use conduit bodies as junction and pull boxes where no splices are required and allowed by applicable codes.
6. Install pull boxes where necessary in raceway system to facilitate conductor installation.
7. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.
8. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.

B. Flush Mounted:

1. Install with concealed conduit.
2. Holes in surrounding surface shall be no larger than required to receive box.
3. Make edges of boxes flush with final surface.

C. Mounting Hardware:

1. Noncorrosive Dry Areas: Galvanized.
2. Noncorrosive Wet Areas: Stainless steel.
3. Corrosive Areas: Stainless steel.

D. Supports:

1. Support boxes independently of conduit by attachment to building structure or structural member.
2. Install bar hangers in frame construction or fasten boxes directly as follows:
 - a. Wood: Wood screws.
 - b. Concrete or Brick: Bolts and expansion shields.
 - c. Hollow Masonry Units: Toggle bolts.
 - d. Steelwork: Machine screws.
3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
4. Boxes embedded in concrete or masonry need not be additionally supported.

E. At or Below Grade:

1. Install boxes for below grade conduit flush with finished grade in locations outside of paved areas, roadways, or walkways.
2. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.

GRFF OZONE SYSTEM REPLACEMENT

3. Obtain Owner's written acceptance prior to installation in paved areas, roadways, or walkways.
4. Use boxes and covers suitable to support anticipated weights.

3.11 EMPTY RACEWAYS

- A. Provide permanent, removable cap over each end.
- B. Provide PVC plug with pull tab for underground raceways with end bells.
- C. Provide nylon pull cord.
- D. Identify, as specified in Article Identification Devices, with waterproof tags attached to pull cord at each end, and at intermediate pull point.
- E. Identify location on the Record Drawings.

3.12 IDENTIFICATION DEVICES

- A. Raceway Tags:
 1. Identify Raceway Schedule designation.
 2. For exposed raceways, install tags at each terminus, near midpoint, and at minimum intervals of every 50 feet, whether in ceiling space or surface mounted.
 3. Install tags at each terminus for concealed raceways.
 4. Provide noncorrosive wire for attachment.

3.13 PROTECTION OF INSTALLED WORK

- A. Protect products from effects of moisture, corrosion, and physical damage during construction.
- B. Provide and maintain manufactured watertight and dust-tight seals over conduit openings during construction.
- C. Touch up painted conduit threads after assembly to cover nicks or scars.
- D. Touch up coating damage to PVC-coated conduit with patching compound approved by manufacturer. Compound shall be kept refrigerated according to manufacturers' instructions until time of use.

END OF SECTION

**SECTION 26 05 70
ELECTRICAL SYSTEMS ANALYSIS**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section. Current edition applicable:
1. American National Standards Institute (ANSI).
 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
 - b. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - c. 399, Recommended Practice for Industrial and Commercial Power System Analysis.
 - d. 519, Recommended Practices and requirements for Harmonic Control in Electrical Power Systems.
 - e. 1584, Guide for Performing Arc Flash Hazard Calculations, 2018 edition.
 3. National Electrical Manufacturers Association (NEMA): Z535.4, Product Safety Signs and Labels.
 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70E, Standard for Electrical Safety in the Workplace.
 5. Occupational Safety and Health Standards (OSHA): 29 CFR, Part 1910 Subpart S, Electrical.

1.02 SUBMITTALS

- A. Action Submittals (refer to Article Sequencing and Scheduling):
1. Initial Short circuit study.
 2. Final Short circuit study.
 3. Initial Protective Device Coordination Study: Submit within 60 days after approval of initial short circuit study.
 4. Final Protective Device Coordination Study.
 5. Harmonic Study.
 6. Arc Flash Study: Submit initial study with protective Device Coordination Study. Submit final study prior to equipment energization.
 7. Arc flash warning labels; submit sample with initial study.

GRFF OZONE SYSTEM REPLACEMENT

8. Electronic files on USB flash drive of final studies with Record Drawings and verification of protective device settings, including all engineering software input files, output reports, and libraries.
9. Submit final labels prior to energizing equipment.

1.03 QUALITY ASSURANCE

- A. Short circuit and protective device coordination and arc flash studies shall be prepared by Siemens.

1.04 SEQUENCING AND SCHEDULING

- A. Initial complete short circuit study shall be submitted and reviewed before Engineer will review Shop Drawings for switchboard and MCC equipment.
- B. Initial complete protective device coordination and arc flash studies shall be submitted within 90 days after approval of initial short circuit study.
- C. Initial complete arc flash study shall be submitted and accepted prior to energization of the electrical equipment.
- D. Revised short circuit, protective device coordination, and arc flash studies, and arc flash labels shall be submitted and installed on equipment 10 days before energizing electrical equipment.
- E. Final short circuit, protective device coordination, harmonic, and arc flash studies shall be completed prior to Project Substantial Completion. Final version of study shall include as-installed equipment, materials, and parameter data or settings entered into equipment based on study.
- F. Submit final arc flash labels described herein and in compliance with NEMA Z535.4 prior to approved Facility Performance Demonstration/Certificates.

1.05 GENERAL STUDY REQUIREMENTS

- A. Equipment and component titles used in the studies shall be identical to equipment and component titles shown on the Drawings.
- B. Perform studies using one of the following electrical engineering software packages:
 1. SKM Power Tools for Windows, latest version, to update the existing model. No exceptions.

- C. Perform complete fault calculations for each existing source combination: Source combination may include present and future power company supply circuits, large motors, or generators.
- D. Utilize proposed and existing load data for study obtained from Contract Documents and from field investigation of system configuration, wiring information, and equipment.
- E. Existing System and Equipment:
 - 1. Extent of existing system to be included in study is all of the existing system and equipment.
 - 2. Include fault contribution of existing motors and equipment in study.
 - 3. Include existing impedance elements in the study.
 - 4. Include protective devices in series with new equipment.

1.06 SHORT CIRCUIT STUDY

- A. General: Obtain existing model from Owner and update accordingly for this project. Use a copy for the new study so the same basis can be used and the original file remains intact.
- B. Provide:
 - 1. Calculation methods and assumptions and different scenarios.
 - 2. L-L, L-G, and 3-phase bolted faults.
 - 3. Tabulations of calculated quantities.
 - 4. Results, conclusions, and recommendations.
 - 5. Selected base per unit quantities.
 - 6. One-line diagrams with short circuit values identified with an "X."
 - 7. Source impedance data, including x/r ratio, electric utility system and motor fault contribution characteristics.
 - 8. Impedance diagrams.
 - 9. Zero-sequence impedance diagrams.
- C. Calculate short circuit interrupting and momentary (when applicable) duties for assumed faults listed above at each:
 - 1. Electric utility's supply termination point (primary meter).
 - 2. 12 kV switch.
 - 3. 12 kV/480V transformer.
 - 4. 480-Volt switchgear
 - 5. Main switchboard.
 - 6. Low-voltage switchboards.
 - 7. Motor control centers.
 - 8. Standby generators.

GRFF OZONE SYSTEM REPLACEMENT

9. Branch circuit panelboards.
10. Veolia PSUs.
11. Control panels.
12. Motor controllers and motors.
13. Future load contributions as shown on one-line diagram.

D. Verify:

1. Equipment and protective devices, including VFDs, are applied within their ratings.
2. Adequacy of switchgear, switchboards, and motor control centers bus bars to withstand short circuit stresses.
3. Cable and busway sizes for ability to withstand short circuit heating, in addition to normal load currents.

E. Tabulations:

1. General Data:
 - a. Short circuit reactances of rotating machines.
 - b. Cable and conduit material data.
 - c. Bus data.
 - d. Transformer data.
 - e. Circuit resistance and reactance values.
 - f. Standby generator data and protection curve.
2. Short Circuit Data for each source combination:
 - a. Fault impedances.
 - b. X to R ratios.
 - c. Asymmetry factors.
 - d. Motor contributions.
 - e. Short circuit kVA.
 - f. Symmetrical and asymmetrical fault currents.
3. Equipment Evaluation:
 - a. Equipment bus bracing, equipment short circuit rating, transformer, cable, busway, and standby generator.
 - b. Maximum fault current available.

F. Written Summary:

1. Scope of studies performed.
2. Explanation of bus and branch numbering system.
3. Prevailing conditions.
4. Selected equipment deficiencies.
5. Results of short circuit study.
6. Comments or suggestions.
7. Assumptions and impact on the short circuit and arc flash study.

- G. Suggest changes and additions to equipment rating and/or characteristics.
- H. Notify Engineer in writing of existing circuit protective devices improperly rated for new fault conditions.
- I. Revise data for “as-installed” condition.
- J. Ground protective coordination shown on separate sheet.

1.07 PROTECTIVE DEVICE COORDINATION STUDY

A. General:

1. Prepare in accordance with IEEE 242.
2. Proposed protective device coordination time-current curves for distribution system, graphically displayed on conventional log-log curve sheets.
 - a. Provide separate curve sheets for phase and ground fault coordination for each scenario.
 - b. Each curve sheet to have title and one-line diagram that applies to specific portion of system associated with time-current curves on that sheet. Limit number of devices shown to four.
 - c. Identify device associated with each curve by manufacturer type, function, and, if applicable, recommended tap, time delay, instantaneous and other settings recommended.
 - d. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
 - e. Apply motor protection methods that comply with NFPA 70.
 - f. Conductor’s thermal with stand curves.

B. Plot Characteristics on Curve Sheets:

1. Electric utility’s relays.
2. Electric utility’s fuses including manufacturer’s minimum melt, total clearing, tolerance, and damage bands.
3. Medium-voltage equipment relays.
4. Medium-voltage and low-voltage fuses including manufacturer’s minimum melt, total clearing, tolerance, and damage bands.
5. Low-voltage equipment circuit breaker trip devices, including manufacturers tolerance bands.
6. Pertinent transformer full-load currents at 100 percent.
7. Transformer magnetizing inrush currents.
8. Transformer damage curves; appropriate for system operation and location.
9. ANSI transformer with stand parameters.

GRFF OZONE SYSTEM REPLACEMENT

10. Significant symmetrical and asymmetrical fault currents.
 11. Motor overload relay settings for motors greater than 40 hp.
 12. Ground fault protective device settings.
 13. Other system load protective devices for largest branch circuit and feeder circuit breaker in each motor control center.
 14. Short circuit current on the horizontal axis.
 15. Base Voltage identified on horizontal axis for each time-current curve.
 16. Motor starting curve.
 17. Standby generator protection curve.
- C. Tabulate Recommended Protective Device Settings with recommendations to reduce incident energy:
1. Relays:
 - a. Current tap.
 - b. Time dial.
 - c. Instantaneous pickup.
 - d. Electronic settings data file.
 2. Circuit Breakers:
 - a. Adjustable pickups.
 - b. Adjustable time-current characteristics.
 - c. Adjustable time delays.
 - d. Adjustable instantaneous pickups.
 - e. I^2t In/Out.
 - f. Zone interlocking.
 - g. Electronic settings data file.
- D. Written Summary:
1. Scope of studies performed.
 2. Summary of protective device coordination methodology.
 3. Prevailing conditions.
 4. Selected equipment deficiencies.
 5. Results of coordination study.
 6. Appendix of complete relay and circuit breaker electronic setting files, submit electronic data files from manufacturer's software.
 7. Comments where coordination is limited and suggestions on how to improve.

1.08 HARMONIC STUDY

- A. Basis for Harmonic Computations: Using Plant One-Line Diagram for current and voltage distortion computations, furnish harmonic filters, line reactors, isolation transformers, or higher pulse converter arrangements required to meet current/voltage distortion limits. Include Veolia PSU documentation that identifies harmonics generated at different loads.
- B. Normal Source Current Harmonic Distortion: Compute normal source individual and total current harmonic distortion at location identified as PCC1, in accordance with IEEE 519.
- C. Normal Source Voltage Harmonic Distortion: Compute normal source voltage harmonic distortion at location identified as PCC3. THD shall not exceed 5 percent, and individual voltage harmonic distortion shall not exceed 3 percent.
- D. Standby Source Current Harmonic Distortion: Compute standby source individual and total current harmonic distortion at location identified as PCC2, in accordance with IEEE 519. Individual current harmonic distortion and total demand distortion expressed as percent of maximum demand load current I_L shall not exceed 3 percent.

1.09 ARC FLASH STUDY

- A. Perform arc flash hazard study after short circuit and protective device coordination study has been completed, reviewed and accepted.
- B. Perform arc flash study in accordance with NFPA 70E, OSHA 29 CFR, Part 1910 Subpart S, and IEEE 1584.
- C. Base Calculation:
 - 1. For each part of electrical power system, determine the following:
 - a. Flash hazard protection boundary.
 - b. Limited approach boundary.
 - c. Restricted approach boundary.
 - d. Incident energy level.
 - e. Glove class required.
- D. Produce arc flash warning labels that list items in Paragraph Base Calculation and the following additional items.
 - 1. Bus name.
 - 2. Bus voltage.

GRFF OZONE SYSTEM REPLACEMENT

- E. Produce bus detail sheets that list items in Paragraph Base Calculation and the following additional items:
 - 1. Bus name.
 - 2. Upstream protective device name, type, and settings.
 - 3. Bus line-to-line voltage.

- F. Produce arc flash evaluation summary sheet listing the following additional items:
 - 1. Bus name.
 - 2. Upstream protective device name, type, settings.
 - 3. Bus line-to-line voltage.
 - 4. Worst case fault condition for the arc flash study.
 - 5. Protective device bolted fault current.
 - 6. Arcing fault current.
 - 7. Protective device trip/delay time.
 - 8. Breaker opening time.
 - 9. Equipment type.
 - 10. Gap.
 - 11. Arc flash boundary.
 - 12. Working distance.
 - 13. Incident energy.

- G. Analyze short circuit, protective device coordination, and arc flash calculations and highlight equipment that is determined to be underrated or causes incident energy values greater than 8 cal/cm². Propose approaches to reduce energy levels.

- H. Prepare report summarizing arc flash study with conclusions and recommendations which may affect integrity of electric power distribution system. As a minimum, include the following:
 - 1. Equipment manufacturer's information used to prepare study.
 - 2. Assumptions made during study.
 - 3. Reduced copy of one-line drawing; 11 inches by 17 inches maximum.
 - 4. Arc flash evaluations summary spreadsheet.
 - 5. Bus detail sheets.
 - 6. Arc flash warning labels printed in color on thermally bonded adhesive backed UV and weather-resistant labels.

PART 2 PRODUCTS

2.01 ARC FLASH WARNING LABELS

- A. Arc flash warning labels printed in color on thermally bonded adhesive backed, UV- and weather-resistant labels. An example label is located following “End of Section” in Figure 1.

PART 3 EXECUTION

3.01 GENERAL

- A. Adjust relay and protective device settings according to values established by coordination study.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify Engineer in writing of required major equipment modifications.
- D. Provide laminated one-line diagrams (minimum size 11 inches by 17 inches) to post on interior of electrical room doors.
- E. Provide arc flash warning labels on the following equipment:
 - 1. Utility metering equipment.
 - 2. 12kV/480V transformer.
 - 3. Incoming service disconnecting means.
 - 4. Switchgear.
 - 5. Switchboards.
 - 6. Motor control centers; feeder and motor starter cubicles
 - 7. Transfer switches.
 - 8. Panelboards.
 - 9. Standby generator main breaker.
 - 10. Control cabinets fed by 120V or greater.
 - 11. Equipment requiring servicing, adjustment, or inspection while energized.

3.02 SUPPLEMENT

- A. The supplement listed below, following “End of Section,” is a part of this specification:
 - 1. Figure 1: Example Arc Flash Label. Obtain from Owner.

END OF SECTION

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section.
Current version applicable:

1. ASTM International (ASTM):
 - a. D877/D877M, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
 - b. D923, Standard Practices for Sampling Electrical Insulating Liquids.
 - c. D924, Standard Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids.
 - d. D971, Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method.
 - e. D974, Standard Test Method for Acid and Base Number by Color-Indicator Titration.
 - f. D1298, Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.
 - g. D1500, Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale).
 - h. D1524, Standard Test Method for Visual Examination of Used Electrical Insulating Liquids in the Field.
 - i. D1533, Standard Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration.
 - j. D1816, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using VDE Electrodes.
2. Institute of Electrical and Electronics Engineers (IEEE):
 - a. 43, Recommended Practice for Testing Insulation Resistance of Electric Machinery.
 - b. 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminators Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV.
 - c. 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
 - d. 95, Recommended Practice for Insulation Testing of AC Electric Machinery (2,300V and Above) with High Direct Voltage.

GRFF OZONE SYSTEM REPLACEMENT

- e. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
 - f. 400, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5 kV and Above.
 - g. 450, Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.
 - h. C2, National Electrical Safety Code.
 - i. C37.20.1, Standard for Metal-Enclosed Low-Voltage (1,000 Vac and below, 3,200 Vdc and below) Power Circuit Breaker Switchgear.
 - j. C37.20.2, Standard for Metal-Clad Switchgear.
 - k. C37.20.3, Standard for Metal-Enclosed Interrupter Switchgear.
 - l. C37.23, Standard for Metal-Enclosed Bus.
 - m. C62.33, Standard Test Methods and Performance Values for Metal-Oxide Varistor Surge Protective Components.
- 3. Insulated Cable Engineers Association (ICEA):
 - a. S-93-639, 5-46 kV Shielded Power Cables for Use in the Transmission and Distribution of Electric Energy.
 - b. S-94-649, Concentric Neutral Cables Rated 5 kV through 46 kV.
 - c. S-97-682, Standard for Utility Shielded Power Cables Rated 5 kV through 46 kV.
 - 4. InterNational Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Equipment and Systems.
 - 5. National Electrical Manufacturers Association (NEMA):
 - a. AB 4, Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
 - b. PB 2, Deadfront Distribution Switchboards.
 - c. WC 74, 5 kV-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
 - 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70B, Recommended Practice for Electrical Equipment Maintenance.
 - c. 70E, Standard for Electrical Safety in the Workplace.
 - d. 101, Life Safety Code.
 - 7. National Institute for Certification in Engineering Technologies (NICET).
 - 8. Occupational Safety and Health Administration (OSHA): CFR 29, Part 1910, Occupational Safety and Health Standards.

1.02 SUBMITTALS

A. Informational Submittals:

1. Submit 45 days prior to performing inspections or tests:
 - a. Testing firm qualifications.
 - b. Schedule for performing inspection and tests.
 - c. List of references to be used for each test.
 - d. Sample copy of equipment and materials inspection form(s).
 - e. Sample copy of individual device test form.
 - f. Sample copy of individual system test form.
2. Energization Plan:
 - a. Prior to initial energization of electrical distribution equipment; include the following:
 - 1) Owner's representative sign-off form for complete and accurate arc flash labeling and proper protective device settings for equipment to be energized.
 - 2) Staged sequence of initial energization of electrical equipment.
 - 3) Lock-Out-Tag-Out plan for each stage of the progressive energization.
 - 4) Barricading, signage, and communication plan notifying personnel of newly energized equipment.
3. Submit test or inspection reports and certificates for each electrical item tested within 30 days after completion of test:
4. Operation and Maintenance Data:
 - a. In accordance with Section 01 78 23, Operation and Maintenance Data.
 - b. After test or inspection reports and certificates have been reviewed by Engineer and returned, insert a copy of each in Operation and Maintenance Manual.
5. Programmable Settings:
 - a. At completion of Performance Demonstration Test, submit final hardcopy printout and electronic files on disc or thumb drive of as-left setpoints, programs, and device configuration files for:
 - 1) Protective relays.
 - 2) Intelligent overload relays.
 - 3) Adjustable frequency drives.
 - 4) Power metering devices.
 - 5) Uninterruptible power supplies.
 - 6) Electrical communications modules.

GRFF OZONE SYSTEM REPLACEMENT

1.03 QUALITY ASSURANCE

A. Testing Firm Qualifications:

1. Corporately and financially independent organization functioning as an unbiased testing authority.
2. Professionally independent of manufacturers, suppliers, and installers of electrical equipment and systems being tested.
3. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.
4. Supervising engineer accredited as Certified Electrical Test Technologist by NICET or NETA and having a minimum of 5 years' testing experience on similar projects.
5. Technicians certified by NICET or NETA.
6. Assistants and apprentices assigned to Project at ratio not to exceed two certified to one noncertified assistant or apprentice.
7. Registered Professional Engineer to provide comprehensive Project report outlining services performed, results of such services, recommendations, actions taken, and opinions.
8. In compliance with OSHA CFR 29, Part 1910.7 criteria for accreditation of testing laboratories or a full member company of NETA.

B. Test equipment shall have an operating accuracy equal to or greater than requirements established by NETA ATS (National Electrical Testing Association Acceptance Testing Specifications).

C. Test Instrument Calibration: In accordance with NETA ATS.

1.04 SEQUENCING AND SCHEDULING

A. Perform inspection and electrical tests after equipment listed herein has been installed.

B. Perform tests with apparatus de-energized whenever feasible.

1. Scheduled with Owner prior to de-energization.
2. Minimized to avoid extended period of interruption to the operating plant equipment.

C. Notify Owner 24 hours prior to performing tests on energized electrical equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Perform tests in accordance with requirements of Section 01 91 14, Equipment Testing and Facility Startup.
- B. Tests and inspections shall establish:
 - 1. Electrical equipment is operational within industry and manufacturer's tolerances and standards.
 - 2. Installation operates properly.
 - 3. Equipment is suitable for energization.
 - 4. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, NFPA 70B NFPA 101, and IEEE C2.
 - 5. All conductors, power and control, subject to reuse have been tested with a megger to validate insulation integrity. Tabulated results shall be submitted showing all circuit conductors passing for reuse or failing to be replaced.
- C. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.
- D. Set, test, and calibrate, circuit breakers, fuses power monitoring meters, and other applicable devices in accordance with values established by short circuit, coordination, and harmonics studies as specified in Section 26 05 70, Electrical Systems Analysis.
- E. Adjust mechanisms and moving parts of equipment for free mechanical movement.
- F. Adjust and set electromechanical electronic relays and sensors to correspond to operating conditions, or as recommended by manufacturer.
- G. Verify nameplate data for conformance to Contract Documents and approved Submittals.
- H. Realign electrical equipment not properly aligned and correct unlevelness per process described in this specification.
- I. Properly anchor electrical equipment found to be inadequately anchored.

GRFF OZONE SYSTEM REPLACEMENT

- J. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench/screw driver to manufacturer's recommendations, or as otherwise specified in NETA ATS.
- K. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.
- L. Provide proper lubrication of applicable moving parts.
- M. Inform Engineer of working clearances not in accordance with NFPA 70.
- N. Investigate and repair or replace:
 - 1. Electrical items that fail tests.
 - 2. Active components not operating in accordance with manufacturer's instructions.
 - 3. Damaged electrical equipment.
- O. Electrical Enclosures:
 - 1. Remove foreign material and moisture from enclosure interior.
 - 2. Vacuum and wipe clean enclosure interior.
 - 3. Remove corrosion found on metal surfaces.
 - 4. Repair or replace, as determined by Engineer door and panel sections having dented surfaces.
 - 5. Repair or replace, as determined by Engineer poor fitting doors and panel sections.
 - 6. Repair or replace improperly operating latching, locking, or interlocking devices.
 - 7. Replace missing or damaged hardware.
 - 8. Finish:
 - a. Provide matching paint and touch up scratches and mars.
 - b. If required because of extensive damage, as determined by Engineer refinish entire assembly.
- P. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents or approved Submittals.

3.02 CHECKOUT AND STARTUP

- A. Voltage Field Test:
 - 1. Check voltage at all circuit breaker line and load terminals in distribution equipment and control panels.

B. Equipment Line Current Tests:

1. Check line current in each phase for each piece of equipment.
2. Make line current check after power company has made final adjustments to supply voltage magnitude or balance.
3. If phase current for a piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

C. Harmonic Tests: Test in accordance with IEEE 519.

3.03 LOW VOLTAGE CABLES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

1. Inspect each individual exposed power cable No. 14 and larger for:
 - a. Physical damage.
 - b. Proper connections in accordance with single-line diagram.
 - c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
 - d. Color coding conformance with specification.
 - e. Proper circuit identification.
2. Mechanical Connections for:
 - a. Proper lug type for conductor material.
 - b. Proper lug installation.
 - c. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
3. Shielded Instrumentation Cables for:
 - a. Proper shield grounding.
 - b. Proper terminations.
 - c. Proper circuit identification.
4. Control Cables for:
 - a. Proper termination.
 - b. Proper circuit identification.
5. Cables Terminated Through Window Type CTs: Verify neutrals and grounds are terminated for correct operation of protective devices.

B. Electrical Tests for Conductors No. 16 and Larger:

1. Insulation Resistance Tests:
 - a. Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors.
 - b. Test each conductor with respect to ground and to adjacent conductors for 1-minute.

GRFF OZONE SYSTEM REPLACEMENT

- c. Evaluate ohmic values by comparison with conductors of same length and type.
 - d. Investigate values less than 50 megohms.
 - 2. Continuity test by ohmmeter method to ensure proper cable connections.
 - 3. Provide test results in table format for all circuits tested.
- C. Low-voltage cable tests may be performed by installer in lieu of independent testing firm.

3.04 INSTRUMENTATION AND CONTROL CABLES

- a. Utilize 500-Volt dc megohmmeter for all instrumentation and control cables.
- b. Investigate values less than 5 megohms.
- c. See section 3.03A for testing requirements.
- d. Provide test results in table format for all circuits tested.

3.05 MEDIUM-VOLTAGE CABLES, 15 KV MAXIMUM

A. Visual and Mechanical Inspection:

- 1. Inspect each individual exposed cable for:
 - a. Physical damage plus jacket and insulation condition.
 - b. Proper connections in accordance with single-line diagram or approved Submittals.
 - c. Proper shield grounding.
 - d. Proper cable support.
 - e. Proper cable termination.
 - f. Cable bends not in conformance with manufacturer's minimum allowable bending radius.
 - g. Proper arc and fireproofing in common cable areas.
 - h. Proper circuit and phase identification.
- 2. Mechanical Connections:
 - a. Proper lug type for conductor material.
 - b. Proper lug installation.
 - c. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturers.
- 3. Conductors Terminated Through Window Type CTs: Verify neutrals and grounds are terminated for correct operation of protective devices.

B. Electrical Tests:

1. Insulation Resistance Tests:
 - a. Utilize 2,500-volt megohmmeter for 5 kV conductors.
 - b. Test each cable individually with remaining cables and shields grounded.
 - c. Test each conductor with respect to ground and to adjacent conductors for 1-minute.
 - d. Evaluate ohmic values by comparison with conductors of same length and type.
 - e. Investigate values less than 50 megohms.
2. Shield Continuity Tests:
 - a. By ohmmeter method on each section of conductor.
 - b. Investigate values in excess of 10 ohms per 1,000 feet of conductors.
3. Acceptance Tests:
 - a. In accordance with IEEE 400, ICEA S-93-639, NEMA WC 74, ICEA S-94-649, and ICEA S-97-682 for insulated conductors.
 - b. Each conductor section tested with:
 - 1) Splices and terminations in place but disconnected from equipment.
 - 2) Remaining conductors and shields grounded in accordance with IEEE 400.
 - c. Apply maximum test voltage per NETA ATS, Table 100.6, based on method (DC, AC, PD, or VLF) used.
 - d. Measure only leakage current associated with conductor.
 - e. Utilize guard ring or field reduction sphere to suppress corona at disconnected terminations.
 - f. Maximum test voltage shall not exceed limits for terminators specified in IEEE 48, IEEE 386, or manufacturer's specifications.
 - g. Apply test voltage in a minimum of five equal increments until maximum acceptable test voltage is reached.
 - 1) Increments not to exceed ac voltage rating of conductor.
 - 2) Record dc leakage current at each step after a constant stabilization time consistent with system charging current.
 - h. Raise conductor to specified maximum test voltage and hold for 15 minutes or as specified by conductor manufacturer. Record leakage current at 30 seconds and 1 minute, and at 1-minute intervals, thereafter.
 - i. Immediately following test, ground conductor for adequate time period to drain insulation stored charge.
 - j. Test results evaluated on a pass/fail basis.

GRFF OZONE SYSTEM REPLACEMENT

3.06 SAFETY SWITCHES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

1. Proper blade pressure and alignment.
2. Proper operation of switch operating handle.
3. Adequate mechanical support for each fuse.
4. Proper contact-to-contact tightness between fuse clip and fuse.
5. Cable connection bolt torque level in accordance with NETA ATS, Table 100.12.
6. Proper phase barrier material and installation.
7. Verify fuse sizes and types correspond to one-line diagram or approved Submittals.
8. Perform mechanical operational test and verify electrical and mechanical interlocking system operation and sequencing.

B. Electrical Tests:

1. Contact Resistance Tests:
 - a. Contact resistance in microhms across each switch blade and fuse holder.
 - b. Investigate deviation of 50 percent or more from adjacent poles or similar switches.

3.07 MOLDED AND INSULATED CASE CIRCUIT BREAKERS

A. General: Inspection and testing limited to circuit breakers rated 100amperes and larger and to motor circuit protector breakers rated 50 amperes and larger.

B. Visual and Mechanical Inspection:

1. Proper mounting.
2. Proper conductor size.
3. Feeder designation according to nameplate and one-line diagram.
4. Cracked casings.
5. Connection bolt torque level in accordance with NETA ATS, Table 100.12.
6. Operate breaker to verify smooth operation.
7. Compare frame size and trip setting with circuit breaker schedules or one-line diagram.
8. Verify that terminals are suitable for 75 degrees C rated insulated conductors.

C. Electrical Tests:

1. Contact Resistance Tests:
 - a. Contact resistance in microhms across each pole.
 - b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.
2. Primary Current Injection Test at factory (with results provided) and secondary injection testing during commissioning to Verify:
 - a. Long-time minimum pickup and delay.
 - b. Short-time pickup and delay.
 - c. Ground fault pickup and delay.
 - d. Instantaneous pickup by run-up or pulse method.
 - e. Trip characteristics of adjustable trip breakers shall be within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - f. Trip times shall be within limits established by NEMA AB 4, Table 5-3. Alternatively, use NETA ATS, Table 100.7.
 - g. Instantaneous pickup value shall be within values established by NEMA AB 4, Table 5-4. Alternatively, use NETA ATS, Table 100.8.

3.08 AC INDUCTION MOTORS

A. General: Inspection and testing limited to motors rated 5 hp and larger.

B. Visual and Mechanical Inspection:

1. Proper electrical and grounding connections.
2. Shaft alignment.
3. Blockage of ventilating air passageways.
4. Operate motor and check for:
 - a. Excessive mechanical and electrical noise.
 - b. Overheating.
 - c. Correct rotation.
 - d. Check vibration detectors, resistance temperature detectors, or motor inherent protectors for functionability and proper operation.
 - e. Excessive vibration, in excess of values in NETA ATS, Table 100.10.
5. Check operation of space heaters.

GRFF OZONE SYSTEM REPLACEMENT

C. Electrical Tests:

1. Insulation Resistance Tests:
 - a. In accordance with IEEE 43 at test voltages established by NETA ATS, Table 100.1 for:
 - 1) Motors above 200 hp for 10-minute duration with resistances tabulated at 30 seconds, 1-minute, and 10 minutes.
 - 2) Motors 200 hp and less for 1-minute duration with resistances tabulated at 30 seconds and 60 seconds.
 - b. Insulation resistance values equal to, or greater than, ohmic values established by manufacturers.
2. Calculate polarization index ratios for motors above 200 hp. Investigate index ratios less than 1.5 for Class A insulation and 2.0 for Class B insulation.
3. Insulation resistance test on insulated bearings in accordance with manufacturer's instructions.
4. Measure running current and voltage, and evaluate relative to load conditions and nameplate full-load amperes.

3.09 LOW-VOLTAGE MOTOR CONTROL

A. Visual and Mechanical Inspection:

1. Proper barrier and shutter installation and operation.
2. Proper operation of indicating and monitoring devices.
3. Proper overload protection for each motor.
4. Improper blockage of air-cooling passages.
5. Proper operation of drawout elements.
6. Integrity and contamination of bus insulation system.
7. Check door and device interlocking system by:
 - a. Closure attempt of device when door is in OFF or OPEN position.
 - b. Opening attempt of door when device is in ON or CLOSED position.
8. Check nameplates for proper identification of:
 - a. Equipment title and tag number with latest construction one-line diagram that includes red-lines.
 - b. Pushbuttons.
 - c. Control switches.
 - d. Pilot lights.
 - e. Control relays.
 - f. Circuit breakers.
 - g. Indicating meters.
9. Verify fuse and circuit breaker sizes and types conform to Contract Documents (construction drawings with redlines).

10. Verify current and potential transformer ratios conform to Contract Documents (construction drawings with redlines).
11. Check operation and sequencing of electrical and mechanical interlock systems by:
 - a. Closure attempt for locked OPEN devices.
 - b. Opening attempt for locked CLOSED devices.
 - c. Key exchange to operate devices in OFF-NORMAL positions.
12. Verify performance of each control device and feature furnished as part of motor control center.
13. Control Wiring:
 - a. Compare wiring to local and remote control, and protective devices with elementary diagrams and construction drawings with redlines.
 - b. Check for proper conductor lacing and bundling.
 - c. Check for proper conductor identification.
 - d. Check for proper conductor lugs and connections.
 - e. Open MCC bucket doors to full extent to verify door-mounted devices are not pulling conductors and no pinching exists.
14. Exercise active components, i.e. door disconnect handle, HOA switches.
15. Inspect contactors for:
 - a. Correct mechanical operations.
 - b. Correct torque of connections.
16. Perform phasing check on double-ended motor control centers to ensure proper bus phasing from each source.

B. Electrical Tests:

1. Current Injection through Overload Unit at 300 Percent of Motor Full-Load Current and Monitor Trip Time:
 - a. Trip time in accordance with manufacturer's published data.
 - b. Investigate values in excess of 120 seconds.
2. Operational test by initiating control devices to affect proper operation.

3.10 UNINTERRUPTIBLE POWER SUPPLIES (UPS)

A. UPS Start-up Inspection and Testing by the UPS manufacturer or manufacturer's representative:

1. Visual Inspection:
 - a. Inspect equipment for signs of damage.
 - b. Verify installation per the Construction Drawings with redlines.
 - c. Inspect cabinets for foreign objects.
 - d. Inspect for any conductor pinching or pulling.

GRFF OZONE SYSTEM REPLACEMENT

- e. Verify neutral and ground conductors are properly sized and configured per vendor requirements as noted on the Vendor Drawings supplied with installation manuals or submittal package.
 - f. Inspect all battery cell cases.
 - 2. Mechanical Inspection:
 - a. Check all control wiring connections for tightness.
 - b. Check all power wiring connections for tightness.
 - c. Check all terminal screws, nuts, and spade lugs for tightness.
 - 3. Electrical Inspection:
 - a. Check all fuses for continuity.
 - b. Confirm input bypass voltage and phase rotation is correct.
 - c. Verify control transformer connections are correct for voltages being used.
 - d. Assure connections and voltage of the battery string(s).
 - e. Battery inspection and certification according to IEEE standards including battery discharge test and recharge.
 - f. Operation under loss of normal power and return to normal power.
 - 4. Unit Start-Up:
 - a. Energize control power.
 - b. Perform control/logic checks and adjust to meet manufacturer specification.
 - c. Verify DC float and equalize voltage levels.
 - d. Verify DC voltage clamp and over-voltage shutdown levels.
 - e. Verify battery discharge, low-battery warning, and low-battery shutdown levels and local, SCADA, and email alarm notification.
 - f. Verify fuse monitor alarms and system shutdown.
 - g. Verify inverter voltages and regulation circuits.
 - h. Verify inverter/bypass sync circuits and set overlap time.
 - i. Perform manual transfers and returns.
 - j. Simulate utility outage at no load.
 - k. Verify proper recharge.
 - l. Confirm laminated operating procedures are available and have been validated. Outline how to operate in order to perform maintenance.
- B. Provide test instruments to record elapsed time between transfers, voltage, current, frequency, waveform, and transients.
- 1. Include services of manufacturer's field service technician to make final adjustments, final connections, and perform final testing.
 - 2. Evidence of transients or phase shifts in graphs which are out of specification will be cause for rejection of system.

- C. Test total system at full load for rated time of system by simulating:
1. Utility power failure all three phases, one phase.
 2. Inverter failure off line.
 3. Inverter failure on line.
 4. Battery failure.
 5. Confirm UPS returns to normal operation when return power.
 6. Confirm self-test passes and email notification is received for self-testing and passed the self-test.

END OF SECTION

SECTION 26 09 13
POWER MEASUREMENT AND CONTROL

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American National Standards Institute (ANSI).
 2. Institute for Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C37.90, Standard for Relays and Relay Systems Associated with Electric Power Apparatus.
 - b. C37.90.1, Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
 - c. C57.13, Standard Requirements for Instrument Transformers.
 3. International Electrotechnical Commission (IEC):
 - a. 60255-26, Measuring Relays and Protection Equipment—Part 26: Electromagnetic Compatibility Requirements.
 - b. 60870-5-104, Telecontrol Equipment and Systems—Part 5-104: Transmission Protocols—Network Access for IEC 60870-5-101 Using Standard Transport Profiles.
 - c. 61850, Communication Networks and Systems for Power Utility Automation.
 4. National Electrical Manufacturers Association (NEMA):
 - a. C12.1, Electric Meters Code for Electricity Metering.
 - b. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 5. Telecommunications Industry Association (TIA):
 - a. 232-F, Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
 - b. 485-A, Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems.

1.02 DEFINITIONS

- A. CT: Current Transformer.
- B. DNP: Distributed Network Protocol.
- C. LCD: Liquid Crystal Display.
- D. LED: Light Emitting Diode.

GRFF OZONE SYSTEM REPLACEMENT

- E. PLC: Programmable Logic Controller.
- F. PT: Potential Transformer.
- G. UCA: Utility Communications Architecture.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Instruction manuals for each type of device.
 - 2. Special features, licensed programming software.
 - 3. Potential and current schematic diagrams.
 - 4. Control and metering schematic diagrams.
 - 5. Interconnection wiring diagrams.
 - 6. Installation and mounting requirements.
 - 7. Complete descriptive literature and renewal parts data.
- B. Informational Submittals: Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

PART 2 PRODUCTS

2.01 POWER METER (PM)

- A. General:
 - 1. Solid state device with LED displays.
 - 2. Direct voltage input up to 600V ac.
 - 3. Current input via current transformer with 5-ampere secondary.
 - 4. Programmable current and potential transformer ratios.
 - 5. Programmable limits to activate up to four alarms.
 - 6. Selectable Voltage Measurements: Line-to-line or line-to-neutral and wye or delta.
- B. Simultaneous Display:
 - 1. Volts, three-phase.
 - 2. Amperes, three-phase.
 - 3. Kilowatts.
 - 4. Kilowatt hours.
 - 5. Profinet communications network capable.
 - 6. kVA.
 - 7. kVAR.
 - 8. Voltage Rating: 95V ac to 135V ac.

9. Manufacturers and Products:
 - a. Allen Bradley; Model 5000 Series.
 - b. Eaton; IQ DP-4000.
 - c. Siemens Sentron Series, Pac3220.

2.02 INSTRUMENT TRANSFORMERS

A. Current Transformer (CT), 600 Volts and Below:

1. Type: Molded bar or donut.
2. Accuracy:
 - a. 3 percent for relaying.
 - b. 1.2 percent for metering.
3. Shorting type terminal boards for current transformer leads.

B. Potential Transformer (PT), 600 Volts and Below:

1. Type: Molded.
2. Accuracy Classification: 0.3 at burden imposed by meters and instruments, including future.
3. Primary Fuses: Two, current-limiting.
4. Secondary Fuses: One, current-limiting.

PART 3 EXECUTION

3.01 INSTALLATION

- A. In accordance with manufacturer's written instructions.
- B. As defined in Section 26 08 00, Commissioning of Electrical Systems.

3.02 MANUFACTURER'S SERVICES

- A. Manufacturer's Representative:
 1. Present at distribution equipment factory, Site, and classroom designated by Owner, for the minimum person-days listed below, travel time excluded:
 - a. 2 person-days to enter, confirm, and assist in communications configuration at the distribution equipment. Device settings to be based on values generated in the device coordination study.
 - b. 2 person-days for initial energization and start-up of distribution system equipment.
 - c. 1 person-day for post-startup training of Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by the Engineer.

GRFF OZONE SYSTEM REPLACEMENT

- B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

END OF SECTION

SECTION 26 24 19
LOW-VOLTAGE MOTOR CONTROL CENTERS

PART 1 GENERAL

1.01 SCOPE

- A. The requirements of the Contract, Division 26, Electrical, applies to work in this section. Motor Control Center buckets as specified and as shown on the Drawings shall be furnished and installed by the PIC Integrator.
- B. Replace Owner's existing Siemens Profibus MCC buckets with new Profinet MCC buckets. Salvage the removed buckets to Tacoma Water.
- C. This Project differentiates between a Process Instrumentation and Control (PIC) Installer and a PIC Integrator as follows:
 - 1. Contractor's PIC Installer shall perform all physical installation.
 - 2. Contractor's PIC Integrator, also referred to as MCC Supplier throughout this section, shall:
 - a. Be a certified Siemens Solution Provider.
 - b. Be the MCC Supplier and shall procure the new MCC buckets equipped with Siemens SIMOCODE Pro V PN (Model 3UF7 Series) intelligent motor management and protection relays, and shall be equipped with S2 redundancy.
 - c. Configure, test, commission and certify the operation of the MCC equipment.
- D. PIC Integrator (MCC Supplier) shall be:

S&B, Inc.
13200 SE 30th St, Suite A
Bellevue, WA 98005
Phone: +(1) 425-644-1700
Email: jstead@sb-inc.com

 - 1. The PIC Integrator shall verify with Siemens the replacement buckets will fit the existing MCCs.

GRFF OZONE SYSTEM REPLACEMENT

E. MCC Programming is Required:

1. The I&C sheets provide the basis of required programming within the MCC for manual operation of the motor starters: All motor starters and network switches inside the MCC shall be programmed and factory tested by the PIC Integrator at their local facility prior to shipment.
2. The MCC shall be tested together with the associated PLC based Control Panels and PLC Software prior to delivery to Job Site, to validate the integration before onsite testing.
3. MCC hardware requires specialized configuration, including the network switches and local logic blocks within each motor starter.

F. Equipment related to this section is found in the table below:

Tag #	Service	Mount	NEMA	Dimensions	Location	Supplier/Contractor/PIC Integrator
31-MCC-01	Ozone Generation System	Floor	1	See the Drawings	Generation Building	S&B, Inc.
32-MCC-01	Ozone Injection and Headworks Systems	Floor	1	See the Drawings	Lower Floor of Headworks Building	S&B, Inc.
33-MCC-01	Ozone Destruct System	Floor	1	See the Drawings	Sample Station 1	S&B, Inc.

1.02 RELATED SECTIONS

- A. Section 26 09 13, Power Measurement and Control.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's printed product data.
- B. Documents: Submit Shop Drawings for approval. Documents shall include all dimensions, weights, electrical ratings, wiring diagrams and required clearances.
1. Itemized Bill of Material.
 2. Dimensional drawings including network cable barrier locations.
 3. Bus data.
 4. Protective Devices: Copies of time-current characteristics.
 5. Interior Network/Communication cabling and components.

6. Communications protocol setup and parameter setting information for plant control system communication programming.
7. Anchoring instructions and details.
8. Tabulation:
 - a. Motor name; tag (equipment) numbers as shown on the Drawings.
 - b. Motor horsepower.
 - c. Nameplate full load current and Voltage.
 - d. Measured load current and voltage from Commissioning specification.
 - e. Smart overload model number, trip class, and setting.
 - f. Protective device trip settings.
 - g. Manufacturer's solid state starter switch or dip switch or program settings.
 - h. Attach above typed, tabulated data to a copy of starter manufacturer's overload relay or setting selection tables for starters provided.
 - i. Control diagrams.
 - j. Schematic (elementary) diagrams.
 - k. Outline diagrams.

1.04 RELATED STANDARDS

- A. The Motor Control Center shall be manufactured and tested according to the latest applicable standards of the following agencies:
 1. National Electrical Manufacturers' Association (NEMA):
 - a. ICS 18-2001, Motor Control Centers.
 - b. ICS 1-2001, Industrial Control and Systems: General Requirements.
 - c. ICS 2.3-2008, Industrial Control and Systems: Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers.
 2. UL: 845, Motor Control Centers.

1.05 QUALITY ASSURANCE

- A. Manufacturer: For equipment required for the work of this section, provide products which are the responsibility of one manufacturer.
- B. Manufacturer shall have had produced similar electrical equipment for a minimum of 5 years.
- C. Manufacturer shall be Siemens, ISO 9001; 2008 certified.

GRFF OZONE SYSTEM REPLACEMENT

- D. Contractor's PIC Installer shall perform all physical installation and shall have minimum 5 years' experience installing similar systems. Work shall be performed with equipment de-energized.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manual. Supply document as part of the submittal package to allow the Contractor to plan for the handling of the equipment. Supply one copy of this document with the MCC equipment at the time of shipment. Equipment shall be suitably protected from the environment during shipment and during storage to prevent any damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. The motor control center replacement buckets shall be TIASTAR by Siemens, without exception, as configured by PIC Integrator.

2.02 GENERAL REQUIREMENTS

- A. Units (Buckets):
 - 1. Plug-in units shall connect to the vertical bus by means of self-aligning, tin plated copper stab-on connectors provided with spring steel back-up springs to insure positive connection to the vertical bus.
 - 2. When vertical ground bus is present, plug-in units shall include a ground stab which engages the vertical ground bus before the power stabs engage the vertical bus when the unit is inserted into the structure. When the plug-in unit is withdrawn from the vertical bus, the vertical ground stab shall release after the power stabs.
 - 3. All plug-in units 12 inches tall and larger will include two auxiliary handles to aid in installation, removal and transporting plug-in units.
 - 4. All plug-in units will include a racking mechanism to assure full engagement with the stab-on connectors with the vertical bus.
 - 5. A mechanical interlock shall be supplied on all plug-in units to prevent insertion or removal of a unit from the structure when the unit operator handle is in the ON position. This interlock may not be defeated.
 - 6. Each 12-inch tall and larger plug-in unit shall be secured in the structure by two readily accessible devices, one of which is tool operated. These devices shall be located at the front of the unit.
 - 7. Plug-in units with NEMA Type B or NEMA Type C wiring shall be supplied with unit terminal block mounted within the unit, adjacent to the vertical wireway. For nonhigh density units, the terminal blocks shall be mounted on a movable bracket that maintains the terminals

- inside the unit structure for normal operation and pivots into the vertical wireway exposing the terminals for wiring, test, and maintenance.
8. All plug-in units shall include a positive means of grounding the unit to the structure at all times.
 9. The MCC unit disconnect operator shall operate in a vertical, up-down, plane. 6-inch units shall operate in a horizontal motion. All unit disconnects shall remain engaged with the disconnect device at all times, regardless of the unit door position. The operating handles shall be interlocked with the unit door so that the door can neither be opened with the disconnect device in the ON position, nor can the disconnect device be turned ON with the unit door open except by operation of a defeater mechanism. Indication of the disconnect device shall be clearly indicated by the position of the operating handle. When applied with circuit breaker devices, the handle shall also provide clear indication of a circuit breaker trip.
 10. When pilot lights, push buttons or sector switches are specified, the devices shall be mounted in a formed metal device panel that is capable of accepting four such devices in any combination. The device panel shall be secured to the unit door for normal operation, or mounted on the plug-in unit as required for unit removal and bench testing.
 11. Pilot devices shall be heavy duty, oil tight 30 mm devices with a NEMA 4 rating. Indicating lights shall be LED push-to-test type. Pilot device contacts shall be rated at 10A, 600V ac (NEMA A600). The pilot device bodies shall be fabricated from metal.
 12. Unit identification nameplate shall be provided for each unit. Nameplates shall be a black surface with white core. Engraving shall cut through the black surface exposing white lettering of the unit designation. Nameplates shall be 1-inch tall by 3-1/2 inches wide with beveled edges. Adhesives or glues are not an acceptable means of mounting unit nameplates.

B. Wiring:

1. The wiring shall be NEMA Class 1.
2. All internal wiring shall be labeled using heat shrink type material.
3. Conductors shall have wire label with two line ID indicating "to" and "from." i.e. "PB1-1/TA-8."

C. Feeders: Feeder disconnects shall be Siemens thermal-magnetic circuit breaker.

GRFF OZONE SYSTEM REPLACEMENT

2.03 SMART MOTOR CONTROL FEATURES

- A. All protective functions shall be programmed on the motor starter unit such that communication with the network connected control system is not required for operation in HAND or OFF modes of operation.
- B. The device shall communicate via PROFINET to a central master controller and provide motor current, in percent of the motor full load amps, input and output data, status messages ON, OFF, under and over current warning, and trip on a continuous cyclical basis.
- C. The user shall have the ability to remotely monitor and program all programmable parameters, diagnostic data, and operating data.
- D. The device shall communicate at a maximum of 100 Mbit PROFINET communication speed, and shall be auto baud rate sensing. The device shall be able to send 244 bytes per telegram and 64 bytes of diagnostics.
- E. In the event of a communication network failure or PLC failure, the device shall operate as a stand-alone device. Upon restoration of the network, the device shall resume communication with the network.
- F. Full Voltage Non-Revering (FVNR) Applications:
 - 1. Siemens Simocode Pro-V units (Model 3UF7 series) shall be supplied for all FVNR starter applications. Simocodes devices shall monitor both current and voltage. Simocode equipment shall be factory installed into each motor starter bucket section.
 - a. Simocode shall be equipped with PROFINET communication capability for communication with each of the plant's Siemens PLCs on the redundant PROFINET control network.
 - b. Supply a Digital Input Module Card as required per the supplied wiring diagrams.
 - c. Supply a Digital Output Module Card as required per the supplied wiring diagrams.
 - d. Supply a Simocode HMI unit (Model 3UF72101AA010) on the door of each MCC.
 - 2. Simocode MCC devices shall be programmed by PIC Integrator only.

2.04 NETWORK

- A. The new Siemens TIASTAR Smart MCC buckets and power monitors shall be connected to the plant control system via PROFINET switch(es) to be installed in a communications bucket in the MCC enclosure. See IC Drawings for network topology for each MCC enclosure or communications panel.

GRFF OZONE SYSTEM REPLACEMENT

- B. MCC buckets shall be supplied using PROFINET protocol and shall be equipped with S2 Redundancy.
- C. Provide and install network switch(es) in each MCC to connect MCC buckets to the plant PROFINET control network. The network cabling and network switches shall be tested and configured at the PIC Integrator facility to simplify commissioning onsite.
- D. Network switches shall be Siemens Scalance Model XC-200 Series switches with two SFP modules (Part No. 6GK59921AM008AA0) located in each SPF port and in the instances where there are two network switches in a single communications bucket, a single-mode, fiber optic jumper cable with duplex, single-mode, LC connectors shall be installed between two switches. All Switches are to be 24V dc powered from a source power supply located in the communications panel nearest to the MCC (eg. provide power for Scalance switch in 31-MCC-01 via a fused 24V dc power circuit in COMM-31000 Communication Panel. Modify this panel as necessary to provide this circuit. Similar for other MCCs).

MCC	Service	Switch Model	Switch Qty in MCC Communications Bucket
31-MCC-01	Ozone Generation Building	Scalance XC-224 G	1
32-MCC-01	Lower Floor of Headworks Building	Scalance XC-224 G	2
33-MCC-01	Ozone Destruct Building	(Switch in COMM-33000)	(Switch in COMM-33000)

- E. All network switches inside the MCC Communication buckets shall be configured per the project drawings for interoperability with the automation network.

2.05 MCC HARDWARE PARAMETERIZATION AND SHOP VALIDATION

A. Factory Parameterization:

1. To ensure the motor starters are parameterized correctly with local logic blocks for the required process safety logic, network switches configured for ring topology, and as designed according to the manufacturers best practices, all motor starters and network switches

inside the MCC shall be programmed by the PIC Integrator, no exceptions.

2. The Ozone System Supplier's (OSS) Programmer shall provide data exchange definitions to the PIC Integrator using Siemens motor starter standards where applicable. The OSS data exchange information for VFDs will follow Telegram 354. Data definitions for the 3RW55 soft starts and Simocode smart overload devices shall be configured by the PIC Integrator, following the prescribed arrangement and order by the OSS. The PIC Integrator's qualified motor starter programmer shall configure each motor starter, and validate data values to the motor starter's process image.
 - a. Configuration shall include setting the Profinet Device Name, IP address, and subnet mask assignments for each motor starter. IP addresses assignments shall be issued and identified by the OSS Programmer during the submittal process and made available to the PIC Integrator for Factory Programming.
 - b. Configurations shall include the arrangement of data definitions for the 3RW55 soft starts and Simocode smart overload devices as prescribed by the OSS Programmer. The OSS Programmer will provide the definitions as part of the submittal process.
 - c. Configuration shall include motor sequencing logic as required for electrical, mechanical, and harmonic mitigation compliance. This logic is programmed so the motor sequence is followed in both HAND and AUTO operations.
 - d. Configuration shall include compliance to process control descriptions found in the IC sheets of the Drawings. This logic is programmed so the logic is followed in both HAND and AUTO operations.

B. Witnessed Factory Test:

1. Prior to MCC bucket delivery to the Job Site, the buckets shall be brought to the facility of the PIC Integrator for complete functional verification of motor starters and network switches. All motor starters shall be verified for proper factory bucket wiring and proper functionality of the process safety interlocks in the local logic blocks. Network switches shall be verified for ring functionality and network assignment. And Power Meters shall be checked for Profinet integration. MCC Shop Test Verifications shall be performed only by the PIC Integrator.
2. The OSS Programmer shall witness the functionality of the MCCs to ensure compliance to the I&C Plans and process control requirements of the plant, as well as the functionality of the network switch.

3. PIC Integrator shall provide review of all motor starter physical wiring against the approved factory wiring diagrams. PIC Integrator and OSS Programmer will highlight the wiring diagram as wiring continuity and functionality is verified. Highlighted wiring diagrams will be scanned and included as part of the memorialized factory test documents.
4. The PIC Integrator shall demonstrate to the OSS Programmer the following functionalities:
 - a. Proper network assignment and device name loading to all devices.
 - b. All specified data definitions are correctly populated in the device image of the motor starters, according to Telegram 354 (for VFDs) and according to the supplied definitions in the OSS Programmer's submittal (for RVSS and FVNR starters).
 - c. Population of values with the motor starter's process image.
 - d. Adherence to motor sequencing logic as required for electrical, mechanical, and harmonic mitigation compliance, followed in both HAND and AUTO operational modes.
 - e. Compliance to process control descriptions found in the IC sheets of the Plans, followed in both HAND and AUTO operational modes.
 - f. All motor nameplate parameters, found in the pump/motor supplier's approved submittal, are pre-loaded into each starter.
 - g. Network Switch Architecture Configuration: The PIC Integrator shall preconfigure all Siemens Scalance Switches in the communication buckets of the MCC. The configuration can be made through the web portal interface of the switch. Each switch must be assigned membership into the fiber ring. The PIC Integrator shall assign the specifically designated ports for LEFT and RIGHT ring directions. The Ring Leader device must also be assigned by the PIC Integrator. And all switches must be set to Active Ring mode. The ring functionality and auto-fail-over must be demonstrated during the shop test.
5. The PIC Integrator shall demonstrate functionality of all motor starters in a single test period of consecutive days.
6. After a successful test, the MCCs shall be released for shipment to the Job Site.

PART 3 EXECUTION

3.01 SUPPLY OF PRE-ENERGIZATION CHEKLIST TO CONTRACTOR

- A. The PIC Integrator shall review the following checklist with the Contractor to ensure the MCCs are protected and ready for startup activities.
- B. Provide a review meeting with the Contractor, lasting 1-hour, to review the following information:
 - 1. Installation Check:
 - a. Verify that mounting clearances are observed.
 - b. Provide forced ventilation as needed to meet ambient conditions of installation.
 - 2. Adjustments and Cleaning: Remove debris from drives and wipe dust and dirt from all components.
 - 3. Testing:
 - a. Check tightness of all accessible mechanical and electrical connections to assure they are torqued to the minimum acceptable manufacture's recommendations.
 - b. Check all installed panels for proper grounding, fastening, and alignment.

3.02 WARRANTY

- A. Equipment manufacturer warrants that all goods supplied shall be free of nonconformities in workmanship and materials for 1-year from date of initial operation, and not more than 18 months from date of shipment.

3.03 INSTALLATION

- A. Installation shall be per the manufacturer's recommendations, written instructions, final Shop Drawings, and Contract Documents. Installation shall be coordinated with adjacent work to ensure proper sequence of construction, clearances and support.

3.04 SPARE PARTS

- A. The following major spare parts shall be furnished as part of a complete set of replacement parts for each size of starter in the MCC:
 - 1. Profinet communication module for Simocode ProV (Model 3UF7 Series) Overload.
 - 2. CControl power transformers.
 - 3. SIMICODE keypads.
 - 4. SIMICODE of each size.

5. Profinet card.
6. I/O module.
7. Elapsed time meter.
8. Circuit breaker and electronic trip unit of each size.

3.05 O&M MANUALS

A. Physical Drawings:

1. The PIC Integrator shall supply paper copies of Factory As-Built Drawings with the shipment of each MCC.
2. Upon completion of startup, the PIC Integrator shall incorporate all redline changes to the Drawings and ship new sets paper copies of the Drawings as the Commissioned As-Built Drawings. Supply a drawing set for each MCC.

B. Electronic Hardware Manual:

1. The PIC Integrator shall supply the O&M Hardware Manual in electronic form to ensure that information is quick to navigate and easy to search for key information. The Manual shall be designed to automatically open in the default web-browser of a computer. Provide a main page with hyperlinks to the following subsections:
 - a. Drawings, including electronic copy on USB thumb drive.
 - b. Packing list.
 - c. Submittal reference.
 - d. Manufacturer hardware reference.
2. Subsection Requirements:
 - a. Each subsection will have a unique HTML web page, with hyperlinks to key files within the category. Details for each subsection are found below:
 - 1) Drawings: List each MCC supplied on the Project, with a hyperlink to the PDF drawing file.
 - 2) Packing List: Provide a link to a PDF packing list, identifying the entire scope of supply for the PIC Integrator.
 - 3) Submittal Reference: Provide link(s) to all approved submittal packages used as part of the PIC Integrator's scope of supply.
 - 4) Manufacturer Hardware Reference: Provide a link to the manufacturer's operations manual for all components used inside the MCCs, including VFDs, 3RW55 Starters, Simocode ProV (Model 3UF7 Series) Overload devices, Pac4200 Series Power Meters, network switches, and ancillary components in each MCC starter buckets.

GRFF OZONE SYSTEM REPLACEMENT

3.06 EQUIPMENT SHIPMENT TO JOB SITE

- A. Following a successful Witness Factory Test, the MCC Supplier shall ship all MCC buckets to the Job Site. The Contractor shall unload, store, and install the equipment.

3.07 STARTUP AND COMISSIONING

- A. The PIC Integrator shall support the power distribution and motor starters from a hardware and configuration standpoint as part of the startup and commissioning process of the process control system. The OSS Programmer will have a network connection to the motor starters, power meters, and network switches, and will only have responsibility to command the equipment using PLC code blocks. All MCC hardware configuration is the responsibility of the PIC Integrator.
- B. The workflow for the startup and commissioning of the process control system will follow a prescribed sequence. The PIC Integrator shall provide the following minimum onsite time to support the Startup and Commissioning effort.

Task	PIC Integrator Function	Minimum Durations per MCC
Verify Correct Installation	Performs onsite inspection	1-day
Initial "Bump Test" of Motor Starters	Supports Contractor to bump test motors to check for rotation	2 days
Commission Motor Starters to Pumps/Motors	Set starter's parameters to meet process control requirements and conditions	3 days
Owner Training	Training for MCC hardware	4 hours
Process Control Functional Acceptance Testing	Must be available and on call to support motor starters during FATs	On Call

1. Verify Correct Installation:
 - a. PIC Integrator shall review each MCC installation to ensure the mounting matches the requirements of the manufacturer's published installation details. If any changes are required, the PIC Integrator and PIC installer shall make corrections.

- b. For all motor starters, the PIC Integrator shall be responsible for verifying the field terminations of all motor starter field wiring, and issuing a correction notice to the Contractor for any deviations. The PIC Integrator shall also be onsite to support the motor bump test.
 - c. PIC Integrator shall verify the network switch ring functionality to the associated PLC control panel.
 2. Initial “Bump” Test of Motor Starters:
 - a. The PIC Integrator shall support the Contractor to “bump” the motor for short starting durations to test the rotation.
 3. Commissioning Motor Starters to Pumps/Motors:
 - a. The PIC Integrator shall be onsite to facilitate commissioning.
 - b. Set the starting parameters for each unit within the motor starter’s configuration software or locally on the motor starter.
 - c. Perform the motor starters internal commissioning function to the coils of the connected pump/motor to capture the resistance and have the starter develop the required configuration.
 - d. Review the starting performance and coincide motor starter configuration updates with the OSS Programmer’s application software adjustments to meet the process requirements.
 - e. Save each starter’s configuration file, and include in the O&M.
 4. Training:
 - a. Provide training on the Simocode, and Power Meter platforms to ensure the Operations staff can troubleshoot, configure, and support the equipment. This training is performed prior to process control testing. Training topics shall include:
 - 1) Navigation and use of the Starter’s Controls.
 - 2) Diagnostics of Faults and Alarms.
 - 3) Operating Starters in HAND.
 - 4) Network Switch Fiber Ring.
 - 5) Power Meter use and menu navigation.
 5. Process Control Functional Acceptance Testing:
 - a. Process Control Functional Acceptance Testing occurs after all drive commissioning and drive operations has been verified to be in working order. Therefore, the PIC Integrator is not required to be onsite during the functional acceptance testing, but the PIC Integrator must be available for On Call support of hardware (such as: drive parameter adjustments) to support the functional acceptance testing of the plant operations.
 - b. If any MCC instrumentation or hardware issues arise, it is the responsibility of the PIC Integrator to resolve so as to not impact the process control testing timeline of the plant.

GRFF OZONE SYSTEM REPLACEMENT

3.08 TRAINING

A. General:

1. Provide an integrated training program to meet specific needs of Owner's personnel.
2. Include training sessions, for operators and maintenance personnel.
3. Provide instruction on one working shift as needed to accommodate the Owner's personnel schedule.
4. Owner reserves the right to make and reuse video tapes of training sessions.

END OF SECTION

SECTION 26 29 23
VARIABLE-FREQUENCY DRIVES

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes separately enclosed, preassembled, combination VFDs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.02 DEFINITIONS

- A. CE: Conformance Europeene (European Compliance).
- B. CPT: Control power transformer.
- C. DDC: Direct digital control.
- D. EMI: Electromagnetic interference.
- E. LED: Light-emitting diode.
- F. NC: Normally closed.
- G. NO: Normally open.
- H. OCPD: Overcurrent protective device.
- I. PID: Control action, proportional plus integral plus derivative.
- J. RFI: Radio-frequency interference.
- K. VFD: Variable-frequency motor controller.
- L. This Project differentiates between a Process Instrumentation and Control (PIC) Installer and a PIC Integrator as follows:
 - 1. Contractor's PIC Installer shall perform all physical installation.
 - 2. Contractor's PIC Integrator, shall:
 - a. Be a certified Siemens Solution Provider.
 - b. Be the VFD Supplier.
 - c. Configure, test, commission and certify the operation of the VFDs.

GRFF OZONE SYSTEM REPLACEMENT

3. PIC Integrator shall be:
S&B, Inc.
13200 SE 30th St, Suite A.
Bellevue, WA 98005.
Phone: +(1) 425-644-1700.
Email: jstead@sb-inc.com.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type and rating of VFD indicated.
 1. Include dimensions and finishes for VFDs.
 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each VFD indicated.
 1. Include mounting and attachment details.
 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings:
 1. Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - a. Required working clearances and required area above and around VFDs.
 - b. Show VFD layout and relationships between electrical components and adjacent structural and mechanical elements.
 - c. Show support locations, type of support, and weight on each support.
 - d. Indicate field measurements.
- B. Qualification Data: For testing agency.
- C. Seismic Qualification Data: Certificates, for each VFD, accessories, and components, from manufacturer.
 1. Certificate of compliance.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.
- D. Product Certificates: For each VFD from manufacturer.
- E. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519. See Section 26 05 70, Electrical Systems Analysis.
- F. Source quality control reports.
- G. Field quality control reports.
- H. Sample Warranty: For special warranty.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For VFDs to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 01 78 23, Operation and Maintenance Data, include the following:
 - a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
 - b. Manufacturer's written instructions for setting field-adjustable overload relays.
 - c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
 - d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
 - e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
 - f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

GRFF OZONE SYSTEM REPLACEMENT

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise onsite testing.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Product Selection for Restricted Space: The Drawings indicate maximum dimensions for VFDs, including clearances between VFDs, and adjacent surfaces and other items.

1.08 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace VFDs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. The variable frequency drive shall be manufactured by Siemens, Type SINAMICS G120, no equal. This model is used to match to existing models used throughout the chemical facility. Each drive shall have the following parts as part of the overall assembly.
 - 1. VFD Assembly:
 - a. Power Module: PM240-2, 1 hp, Part #6SL3210-1PB13-8UL0.
 - b. Control Unit: CU230P-2 DP, Part #6SL3243-0BB30-1PA3.
 - c. Operator Panel: IOP-2, Part #6SL3255-0AA00-4JA2. With door mount kit, Part #6SL32560AP000JA0.
- B. Motor Starter Protector:
 - 1. All motor starter protectors (MSP) shall be made by Siemens, no equal, to ensure the protector has been tested and approved for use with the drives. Protectors may include, but not limited to the 3VA, 3RV, or NGG series from Siemens.
 - 2. Provide a motor starter protector for each drive.

2.02 GENERAL

- A. Provide variable frequency controllers suitable for operating variable or constant torque loads. Controllers shall meet or exceed the ratings listed below:
1. The VFD system shall consist of a 6-pulse AC drive unit.
 2. The circuit breaker shall be rated in accordance with NEC and UL requirements.
 3. The VFD manufacturer shall not predict or be responsible for pre-existing voltage distortion on the line or distortion from sources supplied by others. Maximum input voltage unbalance shall be 0.5 percent as defined in NEMA MG 1, Section 14.35.2.
 4. Rated Input Voltage: 380 volts to 480 volts plus or minus 10 percent, three-phase.
 5. Rated Frequency: 47 Hz to 63 Hz.
 6. Capable of running at a minimum of 150 percent of nameplate current for 3 seconds and then 110 percent of nameplate current for 57 seconds with a cycle time of 300 seconds for Low Overload (LO) rating.
 7. Capable of running at a minimum of 200 percent of nameplate current for 3 seconds and then 150 percent of nameplate current for 57 seconds with a cycle time of 300 seconds for High Overload (HO) rating.
 8. Capable of providing the following safety functions without the use of an external PLC or other controller:
 - a. Capable of Safe Torque Off (STO) to protect against active movement of the drive.
 - b. Capable of Safely Limited Speed (SLS) for protection against movements that can be dangerous due to excessive speed. "Safely Limited Speed" function shall be capable of implementation without a motor mounted encoder or speed sensor.
 - c. Capable of Safe Brake Control (SBC) for controlling motor-holding brakes which are active in the de-energized state
 - d. Capable of Safe Stop1 (SS1) for continuous monitoring of a safe decelerating ramp function. Safe Stop1 shall be capable of implementation without a motor mounted encoder or speed sensor.
 - e. Capable of firmware upgrades using a Micro Memory Card (MMC).
 9. VFD power range to be available from 1/2 hp to 300 hp where VFD shares common programming, human interface, and options.
 10. Motor Nameplate Voltage: 460 volts, three-phase, 60 Hz (as specified on motor list).
 11. Operating Ambient High Overload (HO): 32 degrees F to 122 degrees F or 0 degree C to 50 degrees C Frame Size A to F. 50 degrees C to 60 degrees C with derate

GRFF OZONE SYSTEM REPLACEMENT

12. Operating Ambient High Overload (HO): 32 degrees F to 104 degrees F or 0 degree C to 40 degrees C Frame Size Gx. 40 degrees C to 55 degrees C with derate
13. Operating Ambient Light Overload (LO): 32 degrees F to 104 degrees F or 0 degree C to 40 degrees C Frame Size A to Gx. Derate above 40 degrees C.
14. Minimum Efficiency at Full Load and at Full Speed: 95 percent to 97 percent.

2.03 PRODUCT SPECIFICS

A. The variable speed drive is to have these characteristics:

1. Variable frequency drive shall have modular construction to allow for maximum configuration flexibility.
2. Inputs and outputs for the VFD to include up to nine fully programmable isolated digital inputs with the option for a 10th and 11th. Both scalable analog inputs can also be used as the 10th and 11th digital inputs, two fully programmable analog outputs and three fully programmable digital outputs.
3. Silent motor operation is possible when using high switching frequencies. Drive derating for these higher switching frequencies shall be acceptable.
4. Complete inverter and motor protection.
5. Product to provide simple commissioning macro to program the VFD for the application, motor data and control information. In addition, the drive to provide automatic calibrate routine to optimize motor electrical characteristics within the VFD.

2.04 FEATURES AND PERFORMANCE

A. The VFD is to include these inverter features as a minimum:

1. Latest IGBT technology and Digital microprocessor control.
2. High performance control system can be configured as open or closed loop vector control. Auto tuning for vector control optimization shall be provided. Closed loop control shall be capable of accepting either a TTL or HTL encoder feedback signal. In addition, flux current control, programmable multi-point V/Hz curve, Linear V/Hz control, Quadratic V/Hz control shall be provided.
3. Torque control can be configured in the VFD and activated by command input.
4. Binary Connector (BiCo) technology for customizing signals as required by the application.

5. PID control loop for process control shall be provided with automatic tuning routine.
6. Fast, repeatable digital input response time with NPN/PNP Source-Sink control adaptability. As a minimum, the drive shall provide at least six programmable digital inputs for control of these typical inverter functions:
 - a. On Fwd.
 - b. Fault reset.
 - c. External trip.
 - d. External MOP set point frequency control.
 - e. Fixed frequency presets up to 15 different settings.
 - f. Analog reference switch.
 - g. Activation of Drive or Control Data Sets.
7. As a minimum, the drive shall provide three digital outputs for signal indication of any one of these functions:
 - a. Inverter running.
 - b. Inverter frequency 0 Hz.
 - c. Motor direction in reverse.
 - d. Fault indication.
 - e. Warning active.
 - f. Output current greater than or equal to programmable set point.
 - g. Output frequency greater than or equal to programmable set point.
8. RS-485 serial and USB port to be provided standard in the VFD. STARTER or STARTDRIVE Software Commissioning Tool to be provided for use with a Windows 7 compatible computer.
9. Programmable acceleration/ deceleration, 0 s to 650 s with Multi-curve, adjustable ramp smoothing.
10. Flying restart.
11. Automatic restart following power failure or fault.
12. Fast current limit (FCL) for trip free operation.
13. Fine speed adjustment using a high-resolution 10-bit analog input.
14. Dynamic braking electronic control unit to be built into the control unit up to 200 hp. Injection and Compound braking shall also be provided for rapid controlled braking.
15. Four skip frequencies.
16. The manufacturer of the VFD to provide an Intelligent Operator Panel (IOP-2) capable of controlling the drive and setting the drive parameters. The display will have a color graphic LCD panel that is backlit for easy readability. The operator panel shall have the capability to store up to three different parameter sets. A minimum of five languages will be available in the device. The panel can normally display:
 - a. Frequency in hertz.
 - b. Drive status.

- c. Output voltage.
- d. Output current.
- 17. The digital keypad shall allow operators to enter exact numerical settings in English engineering units. These parameters shall be adjustable for specific Project application requirements onsite. All setup operations and adjustments will be digital, stored in nonvolatile (EEPROM) memory. No analog or potentiometer adjustments will be allowed. As a standard feature, these variables shall be protected from unauthorized tampering, revision, or adjustment by password code. The digital keyboard shall have six keys to provide easy programming of the drive. These keys shall include:
 - a. Sensor control field with integrated arrow keys to increase or decrease output frequency or data values.
 - b. RUN and Stop keys for starting and stopping in the MANUAL mode.
 - c. Program key to enter the program mode and adjust parameters.
- 18. Provide the following short circuit and input protective features:
 - a. Solid state instantaneous overcurrent trip set at 275 percent.
 - b. Under voltage protection.
 - c. Transient surge protection.
 - d. Transistor over temperature and over current protection.
 - e. Current limit circuit to automatically phase back output current and frequency to prevent excessive currents from damaging motor insulation (frequency output rollback).
 - f. Microprocessor fault/memory chip error.
 - g. DC bus over voltage trip.
- 19. Provide the following output protective features:
 - a. Inverse time motor overload protection, UL approved for motor protection, (I squared T trip).
 - b. Thermal sensor detection, thermistor or thermostat for motor over temperature.
 - c. Protection against opening or shorting of motor leads.
 - d. Critical frequency avoidance circuit. Four set points selective from 0 to maximum frequency. Bandwidth of set points to be adjustable.
- 20. The RS485 communications interface, implemented via PROFIBUS DP, shall provide access for monitoring and configuring all operating and fault parameters of the variable frequency drive (VFD). Additionally, the interface shall support the monitoring of digital input status and allow indirect access to relay outputs and analog outputs through parameter control and diagnostic functions.

21. The following conditions shall cause an orderly drive shutdown and lockout:
 - a. Overcurrent at startup.
 - b. Instantaneous over current.
 - c. Over temperature of VFD or external fault.
 - d. Motor over temperature.
 - e. Ground fault in motor output circuit.
 - f. Over voltage during shut down.
 - g. Motor I squared T trip.
22. The drive shall record and display the last four faults that occurred in the drive. The drive shall also display the last warning message experienced by the inverter.
23. The drive shall provide two 0-milliamp to 20-milliamp analog output signals proportional to the output frequency, output current, frequency set point, motor RPM, bus voltage, or inverter heat sink temperature (via BiCo connection).
24. The drive shall have the capability to perform an automatic motor calibration test and adjust its internal settings automatically without any special tools or instruments.
25. The drive shall have the capability to be reset to factory conditions via parameter change.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFDs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Examine VFD before installation. Reject VFDs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

GRFF OZONE SYSTEM REPLACEMENT

3.02 SHOP TEST

- A. Prior to VFD delivery to the Job Site, PIC Integrator shall shop test and verify VFD functionality. All process safety interlocks in the local logic blocks shall be verified for proper functionality.
- B. PIC Integrator shall ensure compliance to the I&C Plans and process control requirements of the plant, as well as the functionality of the VFD on the Profibus network.
- C. The PIC Integrator shall demonstrate the following functionalities:
 - 1. Proper network assignment and device name loading to all devices.
 - 2. Motor nameplate information pre-loaded into the VFD's configuration.
 - 3. Provide ProfiDrive compliant data array for operation and monitoring of VFD over network connection using Siemens Telegram 354. Verify all specified data definitions are correctly populated in the device image of the drive.
 - 4. Population of values with the motor starter's process image.
 - 5. Configure VFD internal function blocks for power factor contactor control, engaging at listed rising load and releasing at independent falling load. Operation shall be independent of network connection with PLC system.
 - 6. Adherence to motor sequencing logic as required for electrical, mechanical, and harmonic mitigation compliance, followed in both HAND and AUTO operational modes.
 - a. Comply with operating narrative for manual operation.
 - 7. Compliance to process control descriptions found in the IC sheets of the Plans, followed in both HAND and AUTO operational modes.
 - 8. All motor nameplate parameters, found in the pump/motor supplier's approved submittal, are pre-loaded into each starter.
- D. The PIC Integrator shall demonstrate functionality of all motor starters in a single test period of 1 day. After a successful test, the VFDs shall be released for shipment to the Job Site.

3.03 INSTALLATION

- A. PIC Integrator shall provide review of all motor starter physical wiring against the approved wiring diagrams for panel LCP-02-PACL-210 and will highlight the wiring diagram as wiring continuity and functionality is verified. Highlighted wiring diagrams will be scanned and included as part of the memorialized factory test documents.

- B. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural steel channels bolted to wall.
- C. Floor-Mounting Controllers: Install VFDs on 4-inch nominal thickness concrete base. Comply with requirements for concrete base specified in Section 03 30 10, Cast-in-Place Concrete.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in each fusible switch VFD.
- F. Install fuses in control circuits if not factory installed.
- G. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.
- H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- I. Comply with NECA 1.

3.04 CONTROL WIRING INSTALLATION

- A. Install wiring between VFDs and remote devices and facility's central-control system. Comply with requirements in Section 26 05 05, Conductors.
- B. Bundle, train, and support wiring in enclosures.

GRFF OZONE SYSTEM REPLACEMENT

- C. Connect selector switches and other automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
 - 2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low-pressure and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.05 IDENTIFICATION

- A. Identify VFDs, components, and control wiring.
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each VFD with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for VFDs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFD units.

3.06 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each VFD element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Inspect VFD, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Test insulation resistance for each VFD element, component, connecting motor supply, feeder, and control circuits.

3. Test continuity of each circuit.
4. Verify that voltages at VFD locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units onsite, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFD. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning by Tacoma Water: Tacoma Water will perform an additional follow-up infrared scan of each VFD 11 months after date of Substantial Completion and address any issues under the warranty.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

- E. VFDs will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies the VFD and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.07 STARTUP SERVICE

- A. Perform startup service: Complete installation and startup checks according to manufacturer's written instructions.

3.08 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

GRFF OZONE SYSTEM REPLACEMENT

- C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

3.09 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace VFDs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.10 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFDs.

3.11 WARRANTY

- A. Equipment manufacturer warrants that all goods supplied are free of nonconformities in workmanship and materials for 2 years from date of initial operation, but not more than 30 months from date of shipment.

END OF SECTION

SECTION 26 33 53
STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes the requirements necessary to furnish and install static uninterruptible power supplies (UPS), including but not limited to:
 - 1. UPS Module(s).
 - 2. System Control Switchgear with static bypass.
 - 3. Battery System.
 - 4. Battery Protective and Disconnect Device(s).
 - 5. Equipment enclosures and racks.
- B. Related Sections:
 - 1. Section 26 05 02, Basic Electrical Requirements.
 - 2. Section 26 05 26, Grounding and Bonding for Electrical Systems.
- C. CAUTION: Use of this section without including the above-listed items results in omission of basic requirements.
- D. In the event of conflict regarding static uninterruptible power supply requirements between this section and another section, the provisions of this section govern.

1.02 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
 - 1. Institute of Electrical and Electronic Engineers, Inc. (IEEE):
IEEE /ANSI C62.41, Recommended Practice for Surge Voltages in Low-voltage AC Power Circuits.
 - 2. International Electrotechnical Commission (IEC): IEC 62040-3
Uninterruptable Power Systems(UPS) – Part 3: Method of Specifying the Performance and Test Requirements.
 - 3. National Electrical Manufacturers Association (NEMA):
 - a. 250 Enclosures for Electrical Equipment.
 - b. PE-1, Uninterruptible Power Systems – Specification and Performance Verification.

GRFF OZONE SYSTEM REPLACEMENT

1.03 DEFINITIONS

A. Abbreviations and Acronyms:

1. Alternating Current (AC).
2. Direct Current (DC).
3. Double Neoprene Pad (DNP).
4. Emergency Power Off (EPO).
5. Insulated Gate Bipolar Transistor (IGBT).
6. Liquid Crystal Display (LCD).
7. Multi-Module Unit (MMU).
8. Pulse-Width Modulation (PWM).
9. Root Mean Squared (RMS).
10. Total Harmonic Distortion (THD).
11. Ultraviolet (UV).
12. Uninterruptible Power Supply (UPS).
13. Volt-Amperes (VA).

1.04 SYSTEM DESCRIPTION

A. System Configuration: Single module Uninterruptible Power System.

- B. Components: System includes battery to provide continuous source of electrical power, rectifier/charger to maintain battery charge and to provide input to inverter when utility power is available, inverter to provide power to load during normal operation, static switch to transfer load automatically and without disturbance between inverter and utility power, manual switch to bypass static switch for maintenance, overall system manual bypass, input and output isolation transformers and filters to provide appropriate isolation and disturbance attenuation, and necessary monitors, sensors, and control circuits. UPS shall be provided with integrated Ethernet communications for remote monitoring and management, and a dry contact interface to enable SCADA system integration for general alarm status monitoring.

C. Modes of Operation:

1. Normal: The inverter(s) continuously powers the critical load. The rectifier/charger(s) derives power from the utility AC source and supplies DC power to the inverter(s), while simultaneously float charging the battery(s).
2. Emergency: Upon utility AC power failure, without any switching, the inverter(s) obtains power from the battery plant(s) and provides uninterrupted power to the critical AC load. Designed to have no interruption in power to the critical load upon failure or restoration of the utility ac source.

3. Recharge: Upon restoration of the utility AC source, the rectifier/charger(s) automatically powers the inverter(s) and simultaneously recharges the battery(s) with no interruption to the critical AC load.
4. Bypass: If the UPS is taken out of service for maintenance or repair, the bypass switch transfers the load to the bypass source with no output disturbance transferred to the AC critical load.
5. Off-battery: For Battery(s) only maintenance, external disconnect breaker(s) disconnects the battery(s) from the rectifier/charger(s) and inverter(s). The UPS module(s) continues to function and meet all of the specified steady-state performance criteria, except for the power outage back-up time capability.

D. Environmental Requirements:

1. Operating Ambient Temperature:
 - a. UPS: 32 degrees F to 104 degrees F.
 - b. Battery: 77 degrees F, plus or minus 5 degrees F.
2. Storage/Transport Ambient Temperature: Minus 13 degrees F to 131 degrees F.
3. Relative Humidity: 0 percent to 95 percent, noncondensing.
4. Altitude:
 - a. Operating: Up to 4,000 feet above mean sea level without derating.
 - b. Storage/Transport: Up to 50,000 feet without derating.
5. Audible Noise: Limit noise generated by UPS under conditions of normal operation below sound pressure level of 75 dB measured at 5 feet from the UPS cabinet.

E. Grounding in accordance with Section 26 05 26, Grounding and Bonding for Electrical Systems.

F. Quality Assurance specified in Section 26 05 02, Basic Electrical Requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect UPS and accessories from moisture by using appropriate heaters or desiccants as instructed by manufacturer.
- B. Store UPS and accessories in a clean, dry space. Maintain wrapping or provide additional heavy canvas or plastic cover to protect from dirt, water, construction debris, and traffic.

GRFF OZONE SYSTEM REPLACEMENT

- C. Handle UPS and accessories in accordance with NEMA and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Eaton.

2.02 SYSTEM RATINGS AND OPERATING CHARACTERISTICS

- A. System Continuous Rating: As shown on the one-line Drawings. Maintain output voltage within specified limits at loads from full load to no load.
- B. Battery Capacity:
 - 1. Discharge Time to End Voltage: 15 minutes at full load, 77 degrees C.
- C. Voltage Rating:
 - 1. Input: Three-phase: 208Y/120 Volts.
 - 2. Output: Three-phase: 208Y/120 Volts.
- D. Equipment Short-Circuit Rating: 22,000 A RMS.

2.03 UPS MODULE PERFORMANCE REQUIREMENTS

- A. Input:
 - 1. Voltage Range: Plus or minus 10 percent.
 - 2. Frequency Range: 60, plus or minus 3 Hz.
 - 3. Inrush Current Limiting: 30 percent of full load rated max.
 - 4. Current Walk-in: 25 percent to 100 percent in 15 seconds.
 - 5. Power Factor: Minimum 0.85 lagging at full load with nominal input voltage.
 - 6. Two-Step Rectifier Input Current Limit:
 - a. Step 1: Factory set at 115 percent (adjustable 100 percent to 125 percent) normal full load input current.
 - b. Step 2: Factory set at 100 percent (adjustable 85 percent to 125 percent) for on-generator operation.
 - 7. Two-step Battery Charge Current Limit:
 - a. Step 1: Factory set at 10 percent (adjustable 1 percent to 25 percent) maximum discharge current.
 - b. Step 2: Factory set at 1 percent (adjustable 1 percent to 25 percent) maximum discharge current.

8. Current Distortion: Less than 7 percent at full load input.
9. Surge Protection: Sustains input surges without damage per criteria listed in ANSI C62.41.
10. Measure harmonic distortion and provide tabulated results.

B. Output:

1. Load Rating: 100 percent continuous load rating at 0-degree F to 104 degrees F for any combination of linear and non-linear load.
2. Voltage Regulation: Plus or minus 1 percent for steady state load.
3. Voltage Adjustment: Plus or minus 5 percent.
4. Free Running Frequency: 60 Hz, plus or minus 1 percent.
5. Frequency Regulation: 0.1 percent.
6. Measure UPS efficiency under the following conditions:
 - a. UPS, operating at full-rated load kVA, and kW.
 - b. Battery, fully charged and floating on system.
 - c. Input voltage within specified range.
 - d. Efficiency: Defined as output kW divided by input kW.
 - e. Minimum Efficiency at Full Load: 95 percent.
7. Phase Displacement:
 - a. 120, plus or minus 1-degree for balanced loads.
 - b. 120, plus or minus 4 degrees for 50 percent unbalanced loads.
8. Unbalanced Voltage Regulation:
 - a. 100 Percent Balanced Loads: Plus or minus 1 percent.
 - b. 100 Percent Unbalanced Loads: Plus or minus 2 percent.
9. Voltage Transients:
 - a. Compliant to IEC 62040-3, Class 1.
 - b. 100 Percent Load Step: Plus or minus 3 percent.
 - c. Loss or Return of AC Input Power: Plus or minus 3 percent with 5-millisecond recovery time.
 - d. Transfer to/from Bypass: Plus or minus 5 percent.
10. Voltage Transient Recovery Time:
 - a. Compliant to IEC 62040-3, Class 1.
 - b. Within 1 percent of output voltage rating within one electrical cycle (16 milliseconds).
11. Harmonic Distortion: Maximum 5 percent RMS voltage THD and maximum 3 percent for any single harmonic, at rated frequency and voltage, from 10 percent load to full load and over battery voltage range, measured into a linear load. Measure harmonic distortion and provide tabulated results.
12. Three-phase Overload Ratings:
 - a. 150 percent for 10 seconds with voltage regulation.
 - b. 125 percent for 2 minutes with voltage regulation.
 - c. 100 percent continuously.
13. Current Limit: 125 percent of rated output current.

GRFF OZONE SYSTEM REPLACEMENT

14. Fault Clearing: Sub-cycle current of at least 300 percent but not more than 500 percent of normal full load current (when bypass is not available).
15. Power Factor: 0.90 lagging.

2.04 DESIGN AND CONSTRUCTION

A. UPS Materials:

1. New high-grade materials for UPS module(s) with solid-state electronic devices, sealed semi-conductors, and control logic and fuses that are physically isolated from power train components.
2. The maximum working voltage, current, and di/dt of solid-state power components and electronic devices shall not exceed 75 percent of the ratings established by their manufacturer.
3. The operating temperature of solid-state component sub-assemblies shall not be greater than 75 percent of their ratings.
4. Electrolytic capacitors shall be computer grade and operated at no more than 95 percent of their voltage rating at the maximum rectifier charging voltage.

B. Mechanical Design Features:

1. Enclosure:
 - a. Construction: NEMA Type 1 enclosure designed for floor mounting.
 - b. Mounting: Structurally adequate with provisions for hoisting, jacking, and forklift handling.
 - c. Allow installation, maintenance, and service of UPS without removal of or access to side or rear panels.
 - d. Allow adequate space and termination facilities for terminating input and output cables with provisions for top and bottom access to input, output, and DC connections.
2. Ventilation:
 - a. Redundant forced air cooling to ensure that components are operated well within temperature ratings.
 - b. Locate air intake at bottom front and air exhaust at top of unit.
 - c. Incorporate removable air filters that do not require shutting down UPS for replacement, are readily accessible and located at air intakes.
 - d. Temperature sensors to monitor UPS internal temperature. Upon detection of temperatures in excess of manufacturer's recommendations, the sensors shall cause audible and visual alarms to be sounded on the UPS panel.

3. Grounding: The AC output neutral shall be electrically isolated from the UPS MMU and SCC chassis. The UPS MMU and SCC chassis shall have an equipment ground terminal. A terminal for bonding the system neutral to the facility service entrance ground (customer-supplied cable) shall be provided.

C. Vibration Isolation:

1. Application: Mount UPS on DNP isolators.
2. DNP:
 - a. Utilize Neoprene pad isolators formed by two layers of 1/4-inch to 3/8-inch thick ribbed or waffled neoprene, separated by stainless steel or aluminum plate. Utilize layers permanently adhered together. Provide Neoprene of 40 durometer to 50 durometer. Size pads so they will be loaded within manufacturer's recommended range. Provide a steel top plate equal to size of pad to transfer weight of support unit to pads and to distribute load evenly over surface of pads.
 - b. Form DNP isolators from one of the following products or approved equal:
 - 1) Type NR: Amber/Booth.
 - 2) Type Korpad: Korfund Dynamics.
 - 3) Type WSW: Mason Industries.
 - 4) Type NPS: Peabody Noise Control.

D. Protection:

1. Built-in self-protection for surges, sags, and overcurrent from the AC source, overvoltage and voltage surges from output terminals of paralleled sources, and load switching and circuit breaker operation in the distribution system.
2. Provide protection against sudden changes in output load and short circuits at the output terminals. Provide built-in protection against permanent damage to itself and the connected load for all predictable types of malfunctions. Use fast-acting current limiting devices to protect against cascading failure of solid-state devices. Internal UPS malfunctions shall cause the module to trip off-line with minimum damage to the module and provide maximum information to maintenance personnel regarding the reason for tripping off-line.
3. Provide control section for monitoring and control. Locate meters, controls, and mimic panel on control section door with alarm functions integral to UPS enclosure, or in a separate alarm panel.

GRFF OZONE SYSTEM REPLACEMENT

- E. Communications: The UPS shall be equipped with an integrated Ethernet communications module. This module shall support SNMP (Simple Network Management Protocol) and web-based monitoring to allow remote access, configuration, and status reporting. The Ethernet interface shall be compatible with the facility's network infrastructure and support integration with existing monitoring systems.
- F. Dry Contact Alarm Interface:
 - 1. The UPS shall include a dry contact output dedicated to indicating general alarm status. This contact shall be configurable to signal any fault or alarm condition that affects UPS operation, including but not limited to battery failure, overload, or bypass operation.
 - a. The dry contact shall be normally open (NO) or normally closed (NC) as required by the SCADA system.
 - b. The contact shall be rated for low-voltage signaling and suitable for direct connection to the facility's SCADA system for remote monitoring.
- G. Maintenance Bypass/Isolation:
 - 1. Description: A make-before-break maintenance bypass switch to route the flow of power to the load around the rectifier/charger, inverter, and static bypass transfer switch.
 - 1. Switch electrically and mechanically interlocked to prevent interrupting power to the load when switching to bypass mode.
 - 2. Switch electrically isolates other UPS components to permit safe servicing.
 - 2. Provide two thermal-magnetic breakers for maintenance bypass and for maintenance isolation. Each circuit breaker shall have an interrupting rating of 65 kAIC. Provide a key interlock system.
 - 3. Key interlock requires unlocking the maintenance bypass breaker before switching from normal position with key that is released only when the UPS is bypassed by the static bypass transfer switch. Lock is designed specifically for mechanical and electrical component interlocking.

2.05 STORAGE BATTERY

- A. Manufacturers:
 - 1. East Penn.
 - 2. Enersys.
 - 3. C&D.

- B. Furnish a storage battery for UPS with sufficient capacity to maintain UPS output at required load for minimum specified time. Battery to provide 100 percent of specified capacity at initial startup. Provide heavy-duty industrial type battery designed for stationary power service.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure enclosures and racks to floor.
- C. Include services of technician to supervise adjustments, final connection, and system energization.
- D. Provide a validated, laminated operating manual for the maintenance bypass switch operation prior to start-up.

3.02 FIELD QUALITY CONTROL

- A. Onsite Tests: Provide onsite factory-trained technician to supervise installation and testing.
- B. Provide start up test results as part of the O&M submittal.
- C. Field UPS Start-up Inspection and Testing:
 - 1. Visual Inspection:
 - a. Inspect equipment for signs of damage.
 - b. Verify installation per the Drawings.
 - c. Inspect cabinets for foreign objects.
 - d. Verify neutral and ground conductors are properly sized and configured per vendor requirements as noted in vendor drawings supplied with installation manuals or submittal package.
 - e. Inspect battery cell cases.
 - f. Inspect each cell for proper polarity.
 - 2. Mechanical Inspection:
 - a. Check control wiring connections for tightness.
 - b. Check power wiring connections for tightness.
 - c. Check terminal screws, nuts, and/or spade lugs for tightness.
 - 3. Electrical Inspection:
 - a. Check fuses for continuity.
 - b. Confirm input bypass voltage and phase rotation is correct.
 - c. Verify control transformer connections are correct for voltages being used.

GRFF OZONE SYSTEM REPLACEMENT

- d. Assure connections and voltage of the battery string(s).
- e. Battery inspection and certification according to IEEE standards.
- 4. Unit Start-Up:
 - a. Energize control power.
 - b. Perform control/logic checks and adjust to meet manufacturer specification.
 - c. Verify DC float and equalize voltage levels.
 - d. Verify DC voltage clamp and over-voltage shutdown levels.
 - e. Verify battery discharge, low battery warning, and low battery shutdown levels.
 - f. Verify fuse monitor alarms and system shutdown.
 - g. Verify inverter voltages and regulation circuits.
 - h. Verify inverter/bypass sync circuits and set overlap time.
 - i. Perform manual transfers and returns.
 - j. Simulate utility outage at no load.
 - k. Verify proper recharge.
 - l. Verify bypass switch kirk key interlock operation.
 - m. Verify output power factor.
- D. Instruct up to ten Owner's personnel for minimum of 1 day in maintenance and operation of equipment.
- E. Test instruments to record elapsed time between transfers, voltage, current, frequency, waveform, and transients.
 - 1. Include services of an experienced technician to make final adjustments, final connections, and perform final testing.
 - 2. Evidence of transients or phase shifts in graphs will be cause for rejection of system.
 - 3. Out of spec harmonics will be cause for rejection.

END OF SECTION

**SECTION 40 05 15
PIPING SUPPORT SYSTEMS**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads for Buildings and Other Structures.
 2. American Society of Mechanical Engineers (ASME): B31.1, Power Piping.
 3. ASTM International (ASTM):
 - a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - b. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
 - c. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 4. International Building Code (IBC).
 5. International Code Council (ICC).
 6. International Mechanical Code (IMC).
 7. Manufacturers' Standardization Society (MSS):
 - a. SP 58, Pipe Hangers and Supports—Materials, Design and Manufacture.
 - b. SP 127, Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, and Application.

1.02 DEFINITIONS

- A. Wetted or Submerged: Submerged, less than 1-foot above liquid surface, below top of channel wall, under cover or slab of channel or tank, or in other damp locations.

1.03 SUBMITTALS

- A. Action Submittals:
1. Catalog information and drawings of piping support system.
 2. Calculations for each type of pipe support, attachment and anchor.
 3. Revisions to support systems resulting from changes in related piping system layout or addition of flexible joints.

GRFF OZONE SYSTEM REPLACEMENT

4. Seismic anchorage and bracing Drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Maintenance information on piping support system.

1.04 QUALIFICATIONS

- A. Piping support systems shall be designed and Shop Drawings prepared and sealed by a Registered Professional Engineer in the state of Washington, where the Work is to be installed.

1.05 DESIGN REQUIREMENTS

A. General:

1. Design, size, and locate piping support systems throughout facility, whether shown or not.
2. Supports are shown only where specific types and locations are required; additional pipe supports may be required.
3. Meet requirements of MSS SP 58 and ASME B31.1 or as modified by this section.

B. Pipe Support Systems:

1. Design pipe support systems for gravity and thrust loads imposed by weight of pipes or internal pressures, including insulation and weight of fluid in pipes.
2. Seismic loads in accordance with governing codes and as shown on the Drawings.
3. Maximum Support Spacing and Minimum Rod Size: In accordance MSS SP 58 Table 3 and Table 4.

- C. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.

- D. Vertical Sway Bracing: 10-foot maximum centers or as shown.

- E. Existing Support Systems: Use existing supports systems to support new piping only if Contractor can show they are adequate for additional load, or if they are strengthened to support additional load.

PART 2 PRODUCTS**2.01 GENERAL**

- A. When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated.
- B. Special support and hanger details may be required for cases where standard catalog supports are not applicable.
- C. Materials: In accordance with Table 1, attached as Supplements at end of section.

2.02 HANGERS

- A. Clevis: MSS SP 58, Type 1:
 - 1. Anvil; Figure 260 for steel pipe and Figure 590 for ductile-iron pipe, sizes 1/2-inch through 30 inches.
 - 2. Insulated Steel Pipe: Anvil; Figure 260 with insulated saddle system (ISS), sizes 1/2-inch through 16 inches.
 - 3. B-Line; Figure B3100, sizes 1/2-inch through 30 inches.

2.03 WALL BRACKETS, SUPPORTS, AND GUIDES

- A. Welded Steel Wall Bracket:
 - 1. MSS SP 58, Type 33 (heavy-duty):
 - a. Anvil; Figure 199, 3,000-pound rating.
 - b. B-Line; Figure B3067, 3,000-pound rating.
- B. Channel Type:
 - 1. Unistrut.
 - 2. Anvil; Power-Strut.
 - 3. B-Line; Strut System.
 - 4. Aickinstrut (FRP).

2.04 CHANNEL TYPE SUPPORT SYSTEMS

- A. Channel Size: 12-gauge, 1-5/8-inch wide minimum steel, or 1-1/2-inch wide, minimum FRP.
- B. Members and Connections: Design for loads using one-half of manufacturer's allowable loads.

GRFF OZONE SYSTEM REPLACEMENT

- C. Fasteners: Vinyl ester fiber, polyurethane base composite nuts and bolts, or encapsulated steel fasteners.
- D. Manufacturers and Products:
 - 1. B-Line; Strut System.
 - 2. Unistrut.
 - 3. Anvil; Power-Strut.
 - 4. Aickinstrut (FRP System).
 - 5. Enduro-Durostrut (FRP Systems).

2.05 PIPE CLAMPS

- A. Riser Clamp: MSS SP 58, Type 8.
 - 1. Anvil; Figure 261, sizes 3/4-inch through 24 inches.
 - 2. B-Line; Figure B3373, sizes 1/2-inch through 30 inches.

2.06 ELBOW AND FLANGE SUPPORTS

- A. Elbow with Adjustable Stanchion: Sizes 2 inches through 18 inches, Anvil; Figure 62C base.
- B. Elbow with Nonadjustable Stanchion: Sizes 2-1/2 inches through 42 inches, Anvil; Figure 63A or Figure 63B base.
- C. Flange Support with Adjustable Base: Sizes 2 inches through 24 inches, Standon; Model S89.

2.07 INTERMEDIATE PIPE GUIDES

- A. Type: Hold down pipe guide.
 - 1. Manufacturer and Product: B-Line; Figure B3552, 1-1/2 inches through 30 inches.
- B. Type: U-bolts with double nuts to provide nominal 1/8-inch to 1/4-inch clearance around pipe; MSS SP 58, Type 24.
 - 1. Anvil; Figure 137 and Figure 137S.
 - 2. B-Line; Figure B3188 and Figure B3188NS.

2.08 PIPE ALIGNMENT GUIDES

- A. Type: Spider.
- B. Manufacturers and Products:
 - 1. Anvil; Figure 255, sizes 1/2-inch through 24 inches.
 - 2. B-Line; Figure B3281 through Figure B3287, sizes 1/2-inch through 24 inches.

2.09 PIPE ANCHORS

- A. Type: Anchor chair with U-bolt strap.
- B. Manufacturer and Product: B-Line; Figure B3147A or Figure B3147B.

2.10 SEISMIC RESTRAINTS

- A. Solid pipe bracing attachment to pipe clevis with clevis cross brace and angle rod reinforcement.
- B. Manufacturers:
 - 1. Mason Industries.
 - 2. B-Line.
 - 3. Anvil.

2.11 ACCESSORIES

- A. Anchor Bolts:
 - 1. Size and Material: Type 316 stainless steel sized by Contractor for required loads.
 - 2. Bolt Length (Extension Above Top of Nut):
 - a. Minimum Length: Flush with top of nut preferred. If not flush, shall be no more than one thread recessed below top of nut.
 - b. Maximum Length: No more than a full nut depth above top of nut.
- B. Dielectric Barriers:
 - 1. Plastic coated hangers, isolation cushion, or tape.
 - 2. Manufacturer and Products:
 - a. B-Line; B1999 Vibra Cushion.
 - b. B-Line; Iso Pipe, Isolation Tape.

GRFF OZONE SYSTEM REPLACEMENT

C. Insulation Shields:

1. Type: Galvanized steel or stainless steel, MSS SP 58, Type 40.
2. Manufacturers and Products:
 - a. Anvil; Figure 167, sizes 1/2-inch through 24 inches.
 - b. B-Line; Figure B3151, sizes 1/2-inch through 24 inches.

D. Plastic Pipe Support Channel:

1. Type: Continuous support for plastic pipe and to increase support spacing.
2. Manufacturer and Product: B-Line; Figure Series B3106V, sizes 1/2-inch through 6 inches with Figure B3106 Vee bottom hanger.

E. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.

F. Attachments:

1. I-Beam Clamp: Concentric loading type, MSS SP 58, Type 21, Type 28, Type 29, or Type 30, which engage both sides of flange.
2. Concrete Insert: MSS SP 58, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.
3. Welded Beam Attachment: MSS SP 58, Type 22.
 - a. Anvil; Figure 66.
 - b. B-Line; Figure B3083.
4. Concrete Attachment Plates:
 - a. Anvil; Figure 47, Figure 49, or Figure 52.
 - b. B-Line; Figure B3084, Figure B3085, or Figure B3086.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Install support systems in accordance with MSS SP 58, unless shown otherwise.
2. Install pipe hanger rods plumb, within 4 degrees of vertical during shut down, start up or operations.
3. Support piping connections to equipment by pipe support and not by equipment.
4. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
5. Support no pipe from pipe above it.

6. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
7. Do not use adhesive anchors for attachment of supports to ceiling or walls.
8. Do not install pipe supports and hangers in equipment access areas or bridge crane runs.
9. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.
10. Install lateral supports for seismic loads at changes in direction.
11. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
12. Repair mounting surfaces to original condition after attachments are completed.

B. Standard Pipe Supports:

1. Horizontal Suspended Piping:
 - a. Single Pipes: Clevis hangers or adjustable swivel split-ring.
 - b. Grouped Pipes: Trapeze hanger system.
2. Horizontal Piping Supported from Walls:
 - a. Single Pipes: Wall brackets, or attached to wall, or to wall mounted framing with anchors.
 - b. Stacked Piping: Wall mounted framing system and “J” hangers acceptable for pipe smaller than 3-inch.
 - c. Pipe clamp that resists axial movement of pipe through support is not acceptable. Use pipe rollers supported from wall bracket.
3. Horizontal Piping Supported from Floors:
 - a. Saddle Supports:
 - 1) Pedestal Type, elbow and flange.
 - 2) Provide minimum 1-1/2-inch grout beneath baseplate.
 - b. Floor Mounted Channel Supports:
 - 1) Use for pipe smaller than 3-inch running along floors and in trenches at pipe elevations lower than can be accommodated using pedestal pipe supports.
 - 2) Attach channel framing to floors with baseplate on minimum 1-1/2-inch nonshrink grout and with anchor bolts.
 - 3) Attach pipe to channel with clips or pipe clamps.
 - c. Concrete Cradles: Use for pipe larger than 3 inches along floor and in trenches at pipe elevations lower than can be accommodated using stanchion type.

GRFF OZONE SYSTEM REPLACEMENT

4. Insulated Pipe:
 - a. Pipe hanger and support shall be on outside of insulation. Do not enclose within insulation.
 - b. Provide precut 120-degree sections of rigid insulation (minimum length same as shield), shields and oversized hangers or insulated saddle system (ISS).
 - c. Wall-mounted pipe clips not acceptable for insulated piping.
5. Vertical Pipe: Support with wall bracket and elbow support, or riser clamp on floor penetration.

C. Standard Attachments:

1. Existing Concrete Ceilings:
 - a. Channel type support with minimum of two anchor points, concrete attachment plates or concrete anchors as limited below:
 - 1) Single point attachment to ceiling is allowed only for 3/4-inch rod and smaller (8 inches and smaller pipe).
 - 2) Where there is vibration or bending considerations do not connect a single pipe support hanger rod directly to a drilled concrete anchor (single point attachment) regardless of size.
2. Steel Beams: I-beam clamp or welded attachments.
3. Concrete Walls: Concrete inserts or brackets or clip angles with concrete anchors.
4. Concrete Beams: Concrete inserts, or if inserts are not used attach to vertical surface similar to concrete wall. Do not drill into beam bottom.

D. Intermediate and Pipe Alignment Guides:

1. Provide pipe alignment guides, or pipe supports that provide same function, at expansion joints and loops.
2. Guide pipe on each side of expansion joint or loop at 4 pipe and 14 pipe diameters from each joint or loop.
3. Install intermediate guides on metal framing support systems not carrying pipe anchor or alignment guide.

E. Accessories:

1. Insulation Shield: Install on insulated piping with oversize rollers and supports.
2. Welding Insulation Saddle: Install on insulated steel pipe with oversize rollers and supports.

3. Dielectric Barrier:
 - a. Provide between painted or galvanized carbon steel members and copper or stainless steel pipe or between stainless steel supports and nonstainless steel ferrous metal piping.
 - b. Install rubber wrap between submerged metal pipe and oversized clamps.

3.02 FIELD FINISHING

- A. Paint atmospheric exposed surfaces hot-dip galvanized steel components as specified here:
 1. Surface Preparation:
 - a. Remove soil, cement spatter, and other surface dirt with appropriate hand or power tools.
 - b. Brush blast in accordance with SSPC SP 16: A brush-off blast cleaned non-ferrous metal surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, metal oxides (corrosion products), and other foreign matter. Intact, tightly adherent coating is permitted to remain. A coating is considered tightly adherent if it cannot be removed by lifting with a dull putty knife. Bare metal substrates shall have a minimum profile of 19 micrometers (0.75 mil).
 - c. Obtain and follow coating manufacturer's recommendations for additional preparation that may be required.
 2. Primer: Epoxy primer, high-build, as recommended by coating manufacturer for specific galvanized metal, copper, or nonferrous metal alloy to be coated.
 - a. Minimum Coats, Cover: One coat, 2.5 MDFT.
 3. Paint: Polyurethane Enamel, match color of existing.
 - a. Minimum Coats, Cover: One coat, 3 MDFT.

3.03 SUPPLEMENT

- A. The supplement listed below, following "End of Section," is a part of this specification:
 1. Table 1: Area Classification.

END OF SECTION

Table 1 Area Classification	
Exposure Conditions	Support Material
Ozone Generator Building (indoor)	Stainless steel or FRP
Pipes conveying Oxygen, Ozone gas, or Ozonated solution	Provide with 316 stainless steel supports
Conduit and Pipes Conveying Water	Provide with painted galvanized supports
Notes: 1. Stainless steel to be Type 304 unless otherwise specified.	

SECTION 40 27 00
PROCESS PIPING—GENERAL AND SPECIALTIES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:
1. Air Force: A-A-58092, Tape, Antiseize, Polytetrafluorethylene.
 2. American Society of Mechanical Engineers (ASME):
 - a. Boiler and Pressure Vessel Code, Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
 - b. B1.20.1, Pipe Threads, General Purpose (Inch).
 - c. B16.3, Malleable Iron Threaded Fittings Class 150 and Class 300.
 - d. B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
 - e. B16.9, Factory-Made Wrought Buttwelding Fittings.
 - f. B16.11, Forged Fittings, Socket-Welding and Threaded.
 - g. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
 - h. B16.25, Buttwelding Ends.
 - i. B31.3, Process Piping.
 - j. B31.9, Building Services Piping.
 - k. B36.19M, Stainless Steel Pipe.
 3. American Society for Nondestructive Testing (ASNT): SNT-TC-1A, Recommended Practice for Personal Qualification and Certification in Nondestructive Testing.
 4. American Water Works Association (AWWA):
 - a. C207, Steel Pipe Flanges for Waterworks Service, Sizes 4 Inches Through 144 Inches (100 mm Through 3,600 mm).
 - b. C213, Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings.
 - c. C606, Grooved and Shouldered Joints.
 5. American Welding Society (AWS):
 - a. Brazing Handbook.
 - b. A5.8M/A5.8, Specification for Filler Metals for Brazing and Braze Welding.
 - c. D1.6/D1.6M, Structural Welding Code – Stainless Steel.
 - d. D18.2, Guide to Weld Discoloration Levels on Inside of Austenitic Stainless Steel Tube.
 - e. QC1, Standard for AWS Certification of Welding Inspectors.

6. ASTM International (ASTM):
 - a. B32, Standard Specification for Solder Metal.
 - b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - d. A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - e. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - f. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - g. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - h. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - i. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 pounds per square inch Tensile Strength.
 - j. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - k. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
 - l. A403/A403M, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
 - m. A563, Standard Specification for Carbon and Alloy Steel Nuts.
 - n. A743/A743M, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
 - o. B61, Standard Specification for Steam or Valve Bronze Castings.
 - p. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - q. B75/B75M, Standard Specification for Seamless Copper Tube.
 - r. D1330, Standard Specification for Rubber Sheet Gaskets.
 - s. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - t. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, Schedule 80, and Schedule 120.
 - u. D2464, Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - v. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

- w. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems. F436, Standard Specification for Hardened Steel Washers.
- x. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- y. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- 7. Compressed Gas Association (CGA): G-4.1, Cleaning of Equipment for Oxygen Service.
- 8. FM Global (FM).
- 9. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS): SP 43, Wrought and Fabricated Butt-Welding Fittings for Low-Pressure, Corrosion Resistant Applications.
- 10. NSF International (NSF):
 - a. ANSI 61 Drinking Water System Components—Health Effects.
 - b. ANSI 372: Drinking Water System Components - Lead Content.

1.02 DESIGN REQUIREMENTS

A. Design and fabricate piping in accordance with the following:

- 1. Process Piping: ASME B31.3, Normal Fluid Service, unless a more stringent fluid category is specified or required.

1.03 SUBMITTALS

A. Action Submittals:

- 1. Shop Fabricated Piping:
 - a. Detailed pipe fabrication or spool drawings showing special fittings and bends, dimensions, coatings, and other pertinent information.
 - b. Layout Drawing showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.
- 2. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

- 1. Manufacturer's Certification of Compliance as required by Section 01 61 00, Common Product Requirements: Pipe and fittings.
- 2. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

GRFF OZONE SYSTEM REPLACEMENT

3. Flanged Pipe and Fittings: Manufacturer's product data sheets for gaskets including torqueing requirements and bolt tightening procedures.
4. Qualifications:
 - a. Nondestructive Testing Personnel: SNT-TC-1A Level II certification and qualifications.
 - b. AWS QC1 Certified Welding Inspector: Submit evidence of current certification prior to commencement of welding activities.
 - c. Welders:
 - 1) Continuity log for welders and welding operators.
 - 2) Welder qualification test records conducted by Contractor or manufacturer.
5. Welding Procedures: Qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX for weld type(s) and base metal(s).
6. Nondestructive inspection and testing procedures.
7. Test logs.
8. CWI inspection records and NDE test records.
9. Certificate of completion of cleaning for oxygen or ozone service.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Independent Inspection and Testing Agency:
 - a. 10 years' experience in field of welding and welded pipe and fittings' testing required for this Project.
 - b. Calibrated instruments and equipment and documented standard procedures for performing specified testing.
 - c. Certified in accordance with ASNT SNT-TC-1A for testing procedures required for this Project.
 - d. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.
2. Welding Procedures: In accordance with ASME BPVC SEC IX (Form QW-482 and Form QW-483) or AWS D1.6/D1.6M (Annex H Forms).
3. Welder Qualifications: In accordance ASME BPVC SEC IX (Form QW-484) or AWS D1.6/D1.6M (Annex H Forms).

B. Contractor's CWI: Certified in accordance with AWS QC1 and having prior experience with specified welding codes. Alternate welding inspector qualifications require approval by Engineer.

1. Quality Assurance: Special inspection to be provided by Owner and performed by independent inspection and testing agency for welding operations.

2. Note, the presence of Owner's Special Inspector or Verification CWI does not relieve Contractor from performing own quality control, including 100 percent visual inspection of welds.
- C. Surface Preparation and Coating Application: Refer to Section 09 90 00, Painting and Coating, for requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Section 01 61 00, Common Product Requirements, and:
 1. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.
 2. Threaded or Socket Welding Ends: Fit with metal, wood, or plastic plugs or caps.
 3. Cold Weather Storage: Locate products to prevent coating from freezing to ground.
 4. Handling: Use heavy canvas or nylon slings to lift pipe and fittings.

PART 2 PRODUCTS

2.01 GENERAL

- A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with NSF/ANSI 61 and the maximum lead content standard in accordance with NSF/ANSI 372.
 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 PIPING

- A. As specified on Piping Data Sheet(s) located at the end of this section as Supplement and on Piping Schedule located on the Drawings.
- B. Diameters Shown:
 1. Standardized Products: Nominal size.
 2. Fabricated Steel Piping (Except Cement-Lined): Outside diameter, ASME B36.10M.
 3. Fabricated Stainless Steel Piping: Outside diameter, ASME B36.19M.

GRFF OZONE SYSTEM REPLACEMENT

2.03 JOINTS

A. Flanged Joints:

1. Flat-faced, carbon steel, or alloy flanges when mating with flat-faced cast or ductile iron flanges.
2. Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher-pressure rating than required for piping.

B. Threaded Joints: NPT taper pipe threads in accordance with ASME B1.20.1.

C. Grooved Couplings:

1. Stainless steel, restrained.
2. Manufacturer and Product: Victaulic, AGS W07.

2.04 GASKET LUBRICANT

- #### A. Lubricant shall be supplied by pipe manufacturer and no substitute or “or-equal” will be allowed.

2.05 PIPE CORROSION PROTECTION

- #### A. Coatings and Linings: Follow coating and linings as described in the Pipe Schedule on the Drawings and in accordance with Section 09 90 00, Painting and Coating.

B. Insulating Flanges, Couplings, and Unions:

1. Materials:
 - a. In accordance with applicable piping material specified in Pipe Data Sheet. Complete assembly shall have ASME B31.3 working pressure rating equal to or higher than that of joint and pipeline.
 - b. Galvanically compatible with piping.
 - c. Resistant for intended exposure, operating temperatures, and products in pipeline.
2. Union Type, 2 Inches and Smaller:
 - a. Screwed or solder-joint.
 - b. O-ring sealed with molded and bonded insulation to body.
3. Flange Type, 2-1/2 Inches and Larger:
 - a. Flanged, complete with bolt insulators, dielectric gasket, bolts, and nuts.
 - b. Bolt insulating sleeves shall be provided full length between insulating washers.
 - c. Ensure fit-up of components of insulated flange assembly to provide a complete functioning installation.

- d. AWWA C207 steel flanges may be drilled oversize up to 1/8-inch to accommodate insulating sleeves.
- e. No less than minimum thread engagement in accordance with specified bolting standards will be permitted to accommodate thicknesses of required washers, flanges, and gasket.
- 4. Flange Insulating Kits:
 - a. Gaskets: Full-face, Type E with elastomeric sealing element. Sealing element shall be retained in a groove within retainer portion of gasket.
 - b. Insulating Sleeves: Full-length mylar or fiberglass reinforced epoxy (NEMA LI-1, G-10 grade).
 - c. Insulating Washers: High-strength phenolic or Fiberglass-reinforced epoxy (NEMA LI-1, G-10 grade).
 - d. Steel Washers: Hardened steel, ASTM F436, 1/8-inch thick. Provide two washers per bolt.
- 5. Manufacturers and Products:
 - a. Dielectric Flanges and Unions:
 - 1) PSI, Houston, TX.
 - 2) Advance Products and Systems, Lafayette, LA.
 - b. Insulating Couplings:
 - 1) Dresser; STAB-39.
 - 2) Baker Coupling Company, Inc.; Series 216.

2.06 FABRICATION

- A. Mark each pipe length on outside with the following:
 - 1. Size or diameter and class.
 - 2. Manufacturer's identification and pipe serial number.
 - 3. Location number on laying Drawing.
 - 4. Date of manufacture.
- B. Code markings according to approved Shop Drawings.
- C. Shop fabricate flanged pipe in shop, not in field, and delivered to Site with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by manufacturer.

2.07 FINISHES

- A. Factory prepare, prime, and finish coat in accordance with Pipe Data Sheet(s) and Piping Schedule and in accordance with Section 09 90 00, Painting and Coating.

GRFF OZONE SYSTEM REPLACEMENT

2.08 PIPE LABELS

- A. Snap-on, reversible type with lettering and directional arrows, sized for outside diameter of pipe and insulation.
- B. Provided with ties or straps for pipes of 6 inches and over diameter.
- C. Designed to firmly grip pipe so labels remain fixed in vertical pipe runs.
- D. Material: Heavy-duty vinyl or polyester, suitable for exterior use, long lasting, and resistance to moisture, grease, and oils.
- E. Letters and Arrows: Label in kind following existing pipe labels and colors.
 - 1. Cooling Water Return (CWR): White text on dark blue background.
 - 2. Cooling Water Supply (CWS): Red text on dark blue background.
 - 3. Dilution Water (DW): Black text on white background.
 - 4. Gaseous Oxygen (GOX): White text on green background.
 - 5. Ozone Gas (O3): Red text on green background.
 - 6. Ozone Solution (O3S): Dark blue text on green background.
 - 7. PSU Coolant Water (GCWS): Black text on white background.
 - 8. Sodium Bisulfite (SBS): Black text on OSHA safety yellow background.
- F. Color Field and Letter Height: Meet ASME A13.1.
- G. Message: Piping system name as indicated on Piping Schedule.
- H. Manufacturers and Products:
 - 1. Brady Signmark; B-915 Brady Snap-On and Strap-On Pipe Markers.
 - 2. Seton Identification Products; Ultra-mark Pipe Markers.

2.09 CONNECTORS

- A. Quick Connect Couplings for Chemical Services:
 - 1. Type: Twin cam arm actuated, male, and female, locking, for chemical loading and transfer.
 - 2. Materials: Glass-filled polypropylene or PVDF with EPDM, Viton-A or Teflon gaskets as recommended for the service by manufacturer.
 - 3. End Connections: NPT threaded or flanged to match piping connections. Hose shank for chemical installations.
 - 4. Plugs and Caps: Female dust cap for each male end; male dust plug for each female end.

5. Pressure Rating: 125 psi, minimum, at 70 degrees F.
6. Manufacturers and Products:
 - a. OPW; Kamlock.
 - b. Ryan Herco; 1300 Series.

2.10 COUPLINGS

A. General:

1. Coupling linings for use in potable water systems shall be in conformance with NSF/ANSI 61.
2. Couplings shall be rated for working pressure not less than indicated in Piping Schedule for the service and not less than 150 psi.
3. Couplings shall be lined and coated with fusion-bonded epoxy in accordance with AWWA C213.
4. Unless thrust restraint is provided by other means, couplings shall be harnessed in accordance with requirements of AWWA Manual M11 or as shown on the Drawings.
5. Sleeve type couplings shall conform to AWWA C219 and shall be hydraulically expanded beyond minimum yield for accurate sizing and proofing of tensile strength.

B. Flexible Sleeve Type Coupling:

1. Manufacturers and Products:
 - a. Steel Pipe:
 - 1) Dresser Piping Specialties; Style 38.
 - 2) Smith-Blair, Inc.; Style 411.
 - b. Ductile Iron Pipe:
 - 1) Dresser Piping Specialties; Style 253.
 - 2) Smith-Blair, Inc.; Style 441.

C. Flanged Coupling Adapter:

1. Anchor studs where required for thrust restraint.
2. Manufacturers and Products:
 - a. Steel Pipe:
 - 1) Dresser Piping Specialties; Style 128.
 - 2) Smith-Blair, Inc.; Style 913.

GRFF OZONE SYSTEM REPLACEMENT

2.11 EXPANSION JOINTS

A. Elastomer Bellows:

1. Type: Reinforced molded wide arch.
2. End Connections: Flanged, drilled 125-pound ASME B16.1 standard, with split galvanized steel retaining rings.
3. Washers: Over retaining rings to help provide leak-proof joint under test pressure.
4. Thrust Protection: Control rods to protect the bellows from overextension.
5. Bellows Arch Lining: Buna-N, nitrile, or butyl.
6. Rated Temperature: 250 degrees F.
7. Rated Deflection and Pressure:
 - a. Lateral Deflection: 3/4 inch, minimum.
 - b. Burst Pressure: Four times the working pressure.
 - c. Compression deflection and minimum working pressure as follows:

Size (inch)	Deflection (inch)	Pressure (psig)
2-1/2 to 12	1.06	150
14	1.65	130
16 to 20	1.65	110

8. Manufacturers and Products:
 - a. General Rubber Corp.; Style 1015 Maxijoint.
 - b. Mercer; Flexmore Style 450.
 - c. Goodall Rubber Co.; Specification E-711.
 - d. Unisource Manufacturing, Inc.; Series 1500.
 - e. Proco Products, Inc.; Series 251.

2.12 MISCELLANEOUS SPECIALTIES

A. Sample Tubing, 1/2 inch and Smaller:

1. Tubing Type: PTFE tubing, 30 psi rated.
2. Fittings: PTFE SwageLok connections and fittings.
3. Manufacturers:
 - a. Cole Parmer.
 - b. MilliporeSigma Supelco.
 - c. Fluorotherm.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.
- B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

3.02 PREPARATION

- A. See Piping Schedule for additional requirements.
- B. Notify Engineer at least 2 weeks prior to field fabrication of pipe or fittings.
- C. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.
- D. Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions.

3.03 WELDING

- A. Perform in accordance with Section IX, ASME Boiler and Pressure Vessel Code and ASME B31.3 for Pressure Piping, and as may be specified on Piping Data Sheets.
- B. Stainless Steel:
 - 1. Use GTAW with inert purging gas for steel groove welds.
 - 2. Limit heat tint to No. 3 or less as defined by AWS D18.2.
- C. Weld Identification: Keep paper record of which welder welded each joint.
- D. Pipe End Preparation:
 - 1. Machine Shaping: Preferred.
 - 2. Oxygen or Arc Cutting: Smooth to touch, true, and slag removal by chipping or grinding.
 - 3. Beveled Ends for Butt Welding: ASME B16.25.

GRFF OZONE SYSTEM REPLACEMENT

E. Surfaces:

1. Clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding.
2. Clean stainless steel joints with stainless steel wire brushes or stainless steel wool prior to welding.
3. Thoroughly clean each layer of deposited weld metal, including final pass, prior to deposition of each additional layer of weld metal with a power-driven wire brush.

F. Alignment and Spacing:

1. Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness.
2. Root Opening of Joint: As stated in qualified welding procedure.
3. Minimum Spacing of Circumferential Butt Welds: Minimum four times pipe wall thickness or 1 inch, whichever is greater.

G. Climatic Conditions:

1. Stainless Steel and Alloy Piping: If ambient is less than 32 degrees F, local preheating to a temperature warm to the hand is required.

H. Tack Welds: Performed by qualified welder using same procedure as for completed weld, made with electrode similar or equivalent to electrode to be used for first weld pass, and not defective. Remove those not meeting requirements prior to commencing welding procedures.

I. Surface Defects: Chip or grind out those affecting soundness of weld.

J. Weld Quality and Nondestructive Testing: Meet requirements of ASME B31.3, Normal Fluid Service category and meet requirements of governing welding codes.

3.04 INSTALLATION—GENERAL

A. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.

B. Remove foreign objects prior to assembly and installation.

C. Flanged Joints:

1. Install perpendicular to pipe centerline.
2. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.

3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.
4. Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast-iron flange.
5. Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.
6. Flange fillers are to be avoided, but, if necessary, may be used to make up for small angles up to 6 degrees and for filling gaps up to 2 inches between flanges. Stacked flange fillers shall not be used.
7. Threaded flanged joints shall be shop fabricated and delivered to Site with flanges in-place and properly faced.
8. Manufacturer: Same as pipe manufacturer.

D. Threaded and Coupled Joints:

1. Conform to ASME B1.20.1.
2. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
3. Countersink pipe ends, ream and clean chips and burrs after threading.
4. Make connections with not more than three threads exposed.
5. Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.

E. Soldered Joints:

1. Use only solder specified for particular service.
2. Cut pipe ends square and remove fins and burrs.
3. After thoroughly cleaning pipe and fitting of oil and grease using solvent and emery cloth, apply noncorrosive flux to the male end only.
4. Wipe excess solder from exterior of joint before hardened.
5. Before soldering, remove stems and washers from solder joint valves.

F. PVC and CPVC Piping:

1. Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
2. Use strap wrench for tightening threaded plastic joints. Do not overtighten fittings.
3. Do not thread Schedule 40 pipe.

3.05 PIPE LABELS

- A. Use Type 2 (Snap-on) labels for pipes 6 inches in diameter and smaller.
- B. Locate at connections to equipment, valves, or branching fittings at wall boundaries.

GRFF OZONE SYSTEM REPLACEMENT

- C. At intervals along piping not greater than 18 feet on center with at least one label applied to each exposed horizontal and vertical run of pipe.
- D. At exposed piping not normally in view, such as above suspended ceilings and in closets and cabinets.
- E. Supplementary Labels: Provide to Owner those listed on Piping Schedule that do not receive arrows.
- F. Apply to pipe after painting in vicinity is complete, or as approved by Engineer.
- G. Install in accordance with manufacturer's instructions.

3.06 INSTALLATION—EXPOSED PIPING

- A. Piping Runs:
 - 1. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
 - 2. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement per manufacturer specifications.
- B. Supports: As specified in Section 40 05 15, Piping Support Systems.
- C. Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.
- D. Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.
- E. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.
- F. Piping clearance, unless otherwise shown:
 - 1. Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.

2. Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
3. From Adjacent Work: Minimum 4 inches from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
4. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.
5. Headroom in front of openings, doors, and windows shall not be less than the top of the opening.
6. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.
7. Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

3.07 PIPE CORROSION PROTECTION

A. Insulating Flanges, Couplings, and Unions:

1. Applications:
 - a. Dissimilar metal piping connections.
 - b. Connections to existing metallic pipe.
 - c. Where required for electrically insulated connection.
2. Pipe Installation: Align and install insulating joints as shown on the Drawings and according to manufacturer's recommendations. Bolt lubricants that contain graphite or other metallic or electrically conductive components that can interfere with the insulating capabilities of the completed flange shall not be used.

3.08 THRUST RESTRAINT

A. Location:

1. Exposed Piping: At all joints in piping.

3.09 BRANCH CONNECTIONS

- A. Do not install branch connections smaller than 1/2-inch nominal pipe size, including instrument connections, unless shown otherwise.
- B. When line of lower pressure connects to a line of higher pressure, requirements of Piping Data Sheet for higher pressure rating prevails up to and including first block valve in the line carrying the lower pressure, unless otherwise shown.

GRFF OZONE SYSTEM REPLACEMENT

C. Threaded Pipe Tap Connections:

1. Welded Steel or Alloy Piping: Connect only with welded threadolet or half-coupling as specified on Piping Data Sheet.
2. Limitations: Threaded taps in pipe barrel are unacceptable.

3.10 INSULATION

- A. See Section 40 42 13, Process Piping Insulation.

3.11 PIPE IDENTIFICATION

- A. Locate at connections to equipment, valves, or branching fittings at wall boundaries.
- B. At intervals along piping not greater than 18 feet on center with at least one label applied to each exposed horizontal and vertical run of pipe.
- C. At exposed piping not normally in view, such as above suspended ceilings and in closets and cabinets.
- D. Supplementary Labels: Provide to Owner those listed on Piping Schedule that do not receive arrows.
- E. Apply to pipe after painting in vicinity is complete, or as approved by Engineer.
- F. Install in accordance with manufacturer's instructions.

3.12 COUPLINGS

- A. General:
1. Install in accordance with manufacturer's written instructions.
 2. Before coupling, clean pipe holdback area of oil, scale, rust, and dirt.
 3. Do not remove pipe coating. If damaged, repair before joint is made.
 4. Application:
 - a. Metallic Piping Systems: Flexible couplings, transition couplings, and flanged coupling adapters.
 - b. Concrete Encased Couplings: Flexible coupling.

3.13 FLEXIBLE PIPE CONNECTIONS TO EQUIPMENT

- A. Install to prevent piping from being supported by equipment, for vibration isolation, and where shown.

B. Product Applications Unless Shown Otherwise:

1. Nonmetallic Piping: Teflon bellows connector.
2. Copper Piping: Flexible metal hose connector.
3. Compressor and Blower Discharge: Metal bellows connector.
4. All Other Piping: Elastomer bellows connector.

C. Limit Bolts and Control Rods: Tighten snug prior to applying pressure to system.

3.14 FIELD FINISHING

A. Field finish in accordance with Section 09 90 00, Painting and Coating.

3.15 FIELD QUALITY CONTROL

A. Pressure Leakage Testing: As specified in Section 40 80 01, Process Piping Leakage Testing.

B. Minimum Duties of Welding Inspector:

1. Job material verification and storage.
2. Qualification of welders.
3. Certify conformance with approved welding procedures.
4. Maintenance of records and preparation of reports in a timely manner.
5. Notification to Engineer of unsatisfactory weld performance within 24 hours of weld test failure.

C. Required Weld Examinations:

1. Perform examinations in accordance with Piping Code, ASME B31.3, for Normal Fluid Service and as specified herein.
2. Radiographically examine 10 percent of CJP butt joint groove welds.
3. Perform examinations for every pipe thickness and for each welding procedure, progressively, for piping covered by this section.
4. Examine at least one of each type and position of weld made by each welder or welding operator.
5. For each weld found to be defective under the acceptance standards or limitations on imperfections contained in the applicable Piping Code, examine two additional welds made by the same welder that produced the defective weld. Such additional examinations are in addition to the minimum required above. Examine, progressively, two additional welds for each tracer examination found to be unsatisfactory.

GRFF OZONE SYSTEM REPLACEMENT

3.16 CLEANING

- A. Following assembly and testing, and prior to final acceptance, flush pipelines, except as stated below, with water at 2.5 fps minimum flushing velocity until foreign matter is removed.
- B. Blow nitrogen gas, oxygen gas, and ozone gas piping clean of loose debris with compressed air at 4,000 fpm; do not flush with water.
- C. Insert cone strainers in flushing connections to attached equipment and leave in-place until cleaning is complete.
- D. Remove accumulated debris through drains 2 inches and larger or by removing spools and valves from piping.
- E. Cleaning for Oxygen or Ozone Service:
 - 1. Piping used for oxygen or ozone services (LOX, GOX, OZG, OZOG) shall be cleaned for oxygen service in accordance with the latest edition of the Compressed Gas Association (CGA) Pamphlet 4.1.
 - 2. Piping cleaned prior to shipment or prior to use shall be sealed and packaged for protection from contamination and tagged as cleaned for oxygen/ozone service as applicable. Precleaned items shall not require further cleaning if their handling and installation meets the requirements of the CGA.
 - 3. Certificate of completion of cleaning for oxygen or ozone service must be submitted and signed by the Owner or Engineer prior to startup of the liquid oxygen and subsequent processes.

3.17 SUPPLEMENTS

- A. The supplements listed below, following “End of Section,” are a part of this specification:

- 1. Data Sheets.

Number	Title
40 27 00.03	Carbon Steel Pipe and Fittings—General Service
40 27 00.08	Stainless Steel Pipe and Fittings—General and Ozone Service
40 27 00.10	Polyvinyl Chloride (PVC) Pipe and Fittings

END OF SECTION

SECTION 40 27 00.03 CARBON STEEL PIPE AND FITTINGS—GENERAL SERVICE		
Item	Size	Description
Pipe	All	Black carbon steel, ASTM A106/A106M, Grade B seamless or ASTM A53/A53M, Grade B seamless or ERW. Threaded, butt-welded, grooved end, and flanged joints:
	Threaded: 1-1/2" & smaller	Standard weight.
	Welded: 2" thru 10"	Standard weight.
	12" thru 16"	Standard weight.
	18" thru 24"	Standard weight.
Joints	Grooved: 2-1/2" thru 6"	Standard weight.
	8" thru 12"	Standard weight.
	14"	Standard weight.
	1-1/2" & smaller	Threaded or flanged at valves and equipment or grooved end meeting the requirements of AWWA C606.
	2" & larger	Butt-welded or flanged at valves and equipment, or grooved end meeting the requirements of AWWA C606.

SECTION 40 27 00.03 CARBON STEEL PIPE AND FITTINGS—GENERAL SERVICE		
Item	Size	Description
Fittings	1-1/2" & smaller	Threaded: 150-pound or 300-pound malleable iron, ASTM A197/A197M or ASTM A47/A47M, dimensions in accordance with ASME B16.3. Fire sprinkler fittings to be UL listed.
	2" & larger	Butt Welded: Wrought carbon steel butt-welding, ASTM A234/A234M, Grade WPB meeting the requirements of ASME B16.9; fitting wall thickness to match adjoining pipe; long radius elbows unless shown otherwise. Grooved End: Malleable iron ASTM A47/A47M, ductile iron ASTM A536, forged steel ASTM A234/A234M, or factory fabricated from ASTM A53/A53M pipe. Grooved ends to accept couplings without field preparation. Victaulic Co.; Anvil International, Inc., Gruvlok; Shurjoint Piping Products.
Branch Connections	1-1/2" & smaller	For Threaded Pipe: Threaded, straight, or reducing tees in conformance with Fittings specified above. For welded or grooved pipe, use threadolet.
	2" & larger	Butt-welding or grooved end tee in conformance with Fittings specified above.

SECTION 40 27 00.03 CARBON STEEL PIPE AND FITTINGS—GENERAL SERVICE		
Item	Size	Description
Flanges	1-1/2" & smaller	Forged carbon steel, ASTM A105/A105M, ASME B16.5, Class 150 flat face.
	2" & larger	Butt-Welded Systems Standard Flange (FFWN): Forged carbon steel, ASTM A105/A105M, ASME B16.5, Class 150 slip-on or welding neck, flat face; weld neck bore to match pipe internal diameter. Use weld neck flanges when abutting butt-weld fittings. Weld slip-on flanges inside and outside. Use when mating flange is plastic. Butt-Welded Systems Blind Flange: Forged carbon steel, ASTM A105/A105M, ASME B16.5, Class 150 or Class 300, facing to match mating flange. Grooved End Adapter Flange: Malleable iron ASTM A47/A47M or ductile iron ASTM A536. Victaulic Style 741 or 743; Anvil International, Inc., Gruvlok Figure 7012 or Figure 7013; Shurjoint Model 7041-A. Include stainless steel washer plates as required for mating to serrated faces and lined valves and equipment.
Unions	1-1/2" & smaller	Threaded malleable iron, ASTM A197/A197 or ASTM A47/A47M, 150-pound or 300-pound WOG, meeting the requirements of ASME B16.3.
Couplings	2" & larger	Grooved End: Rigid joint malleable iron, ASTM A47/A47M or ductile iron, ASTM A536. Victaulic Co.; Anvil International, Inc., Gruvlok; Shurjoint Piping Products. Screwed End: Malleable iron, ASTM A197/A197M or ASTM A47/A47M.

SECTION 40 27 00.03 CARBON STEEL PIPE AND FITTINGS—GENERAL SERVICE		
Item	Size	Description
Bolting	All	Flanges: Carbon steel ASTM A307, Grade B heavy hex or stud bolts; ASTM A563, Grade A heavy hex head nuts. Torque bolts per gasket manufacturer recommendations. When mating flange on equipment is cast iron or plastic, provide ASTM A307, Grade B hex head or stud bolts; ASTM A563, Grade A heavy hex nuts and ASTM F436 hardened steel washers at nuts and bolt heads. Torque bolts per gasket manufacturer recommendations. Grooved End Couplings: Carbon steel, ASTM A183 bolts and nuts, 110,000 pounds per square inch minimum tensile strength.
Gaskets	All flanges	Water, Steam, and Air Services: Gasket, inorganic aramid fiber with nitrile binder, CL150, 1/8-inch thick, Shore A 80 Durometer, ASME B16.21 and ASME B16.5, ASTM D1330, NSF 61. Use full-face or ring type gasket for flat face flange. Insulating Gasket: ASME B16.21 and ASME 16.5, fabric reinforced phenolic neoprene faced gasket, sleeves, washers, CL150, 1/8-inch thick, 175 degrees F Step-Ko; Type E DW, or approved equal. Grooved Couplings: EPDM per coupling manufacturer standard.
Thread Lubricant	1-1/2" & smaller	General Service: 100 percent virgin PTFE Teflon tape.
Linings	All	System No. 1, as detailed in Section 09 90 00, Painting and Coating.
Coatings	All	System No. 4, as detailed in Section 09 90 00, Painting and Coating.

END OF SECTION

SECTION 40 27 00.08 STAINLESS STEEL PIPE AND FITTINGS—GENERAL SERVICE		
Item	Size	Description
Pipe	All 1-1/2" & smaller 2" through 6" 8" & larger	ASTM A312/A312M, Type 316/316L seamless, annealed, pickled and passivated after welding. Use Type 316L for welded joints. Schedule 80S. Schedule 40S. Schedule 10S.
Tubing	All	ASTM A269, Type 316 stainless steel, seamless, soft annealed, 0.083-inch wall thickness minimum.
Joints	1-1/2" & smaller 2" & larger	Threaded or flanged at equipment as required or shown. Butt-welded or flanged at valves and equipment.
Tubing Joints	All	Flareless compression fitting or socket-weld.
Fittings	1-1/2" & smaller 2" & larger	Threaded: Forged, ASTM A182/A182M, Grade F316, 2,000-pound WOG. Butt Welded: ASTM A403/A403M, Grade WP316/316L conforming to ASME B16.9 and MSS SP 43, annealed, fitting wall thickness to match adjoining pipe; long radius elbows, unless shown otherwise. Pickled and passivated in accordance with ASTM A380 after welding.
Tubing Fittings	All	Flareless Compression Type Forged: ASTM A182/A182M, Grade F316, Parker- Hannifin Ferulok; Flodar BA Series

SECTION 40 27 00.08 STAINLESS STEEL PIPE AND FITTINGS—GENERAL SERVICE		
Item	Size	Description
Branch Connections	1-1/2" & smaller	Tee or Reducing Tee: Forged sockolet. or half coupling, Class 2,000 ASTM A182/A182M, Grade.
	2" & larger	Butt-Welding Tee or Reducing Tee: In accordance with fittings above forged weldolet, Class 2,000 ASTM A182/A182M, Grade F316L, same inside diameter as branch pipe.
Tubing Branch Connections	All	Compression type tees or reducing tees in accordance with Tubing Fittings above.
Flanges	All	ASTM A182/A182M Grade F316/316L, ASME B16.5, Class 150, 1/16-inch raised face, slip-on, or weld neck. Weld slip-on flanges inside and outside. Pickled and passivated in accordance with ASTM A380 after welding.
Unions	2" & smaller	Threaded Forged: ASTM A182/A182M, Grade F316, 2,000-pound or 3,000-pound WOG, integral ground seats, AAR design meeting the requirements of ASME B16.11, bore to match pipe.
Bolting	All	Forged Flanges: Type 316 stainless steel, ASTM A193, Grade B8M heavy hex head bolts and ASTM A194/A194M Grade 8M heavy hex head nuts. ASTM A194/A194M Grade 8M hex head nuts and ASTM F844 Type A Narrow Type 316 stainless steel washers dimensioned per ASME 18.21.2 or SAE Type 316 stainless steel washers at nuts and bolt heads. Achieve 40 percent to 60 percent of bolt minimum yield stress.

SECTION 40 27 00.08 STAINLESS STEEL PIPE AND FITTINGS—GENERAL SERVICE		
Item	Size	Description
Gaskets	All Flanges	1/16-inch-thick virgin Teflon or inorganic filled Teflon flat ring type for raised face flanges and full face type for flat face flanges; Garlock or Durlon. For oxygen and ozone related fluid services (LOX, GOX, O3, OG, O3S) gaskets shall be Viton A, 100 percent virgin white Viton with titanium dioxide filler, 60 (Shore A) hardness, compound FDA-615-65-WH supplied by Thermodyn Corporation, "or-equal."
Thread Lubricant (fittings)	2" & smaller	General Service: Nickel pigmented PTFE, designed for stainless steel pipe, Air Force A-A-58092, AA Thread Seal Tape, Inc. Oxygen and Ozone Service: Green Teflon tape designed for oxygen service, Air Force A-A-58092, AA Thread Seal Tape, Inc.
Lining	All	None.
Coating	All	None.

END OF SECTION

SECTION 40 27 00.10 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS		
Item	Size	Description
General	All	Materials in contact with potable water shall conform to NSF 61 acceptance.
Pipe	All	Schedule 80 PVC: Type I, Grade I or Class 12454 conforming to ASTM D1784 and ASTM D1785. Pipe shall be manufactured with titanium dioxide for ultraviolet protection. Threaded Nipples: Schedule 80 PVC.
Fittings	All	Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket weld type and Schedule 80 ASTM D2464 for threaded type. Fittings shall be manufactured with titanium dioxide for ultraviolet protection.
Joints	All	Solvent socket weld except where connection to threaded valves and equipment may require future disassembly.
Flanges	All	One-piece, molded hub type PVC flat face flange in accordance with Fittings above, ASME B16.1, Class 125 drilling.
Bolting	All	Flat Face Mating Flange and In Corrosive Areas: ASTM A193/A193M, Type 316 stainless steel Grade B8M heavy hex head or stud bolts, ASTM A194/A194M Grade 8M heavy hex head nuts and ASTM F436 Type 3 alloy washers at nuts and bolt heads. Torque bolts per gasket manufacturer recommendations.
Gaskets	All	Flat Face Mating Flange: Full faced 1/8-inch-thick Durlon, 9200W RCA, Garlock Gylon 3510.

SECTION 40 27 00.10 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS		
Item	Size	Description
Solvent Cement	All	Socket type joints shall be made employing solvent cement that meets or exceeds requirements of ASTM D2564 and primer that meets or exceeds requirements of ASTM F656, chemically resistant to the fluid service, and as recommended by pipe and fitting manufacturer. Solvent weld cement for PVC pipe joints in chemical service shall be free of silica filler and shall be certified by the manufacturer to be suitable for the intended service, IPS Weld-On 724 "or-equal." Certification shall be submitted. Solvent cement and primer shall be listed by NSF 61 for contact with potable water.
Thread Lubricant	All	Teflon Tape.
Lining	All	None.
Coating	All	None.

END OF SECTION

SECTION 40 27 02
PROCESS VALVES AND PROCESS SPECIALTIES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Society of Mechanical Engineers (ASME): B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
 2. American Water Works Association (AWWA):
 - a. C504, Rubber-Seated Butterfly Valves, 3 Inch (75 mm) Through 72 Inch (1,800 mm).
 - b. C508, Swing-Check Valves for Waterworks Service, 2-Inch Through 24-Inch (50-mm Through 600-mm) NPS.
 - c. C512, Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
 - d. C542, Electric Motor Actuators for Valves and Slide Gates.
 - e. C550, Protective Interior Coatings for Valves and Hydrants.
 3. ASTM International (ASTM):
 - a. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - b. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
 - c. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 - d. A564/A564M, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
 - e. B61, Standard Specification for Steam or Valve Bronze Castings.
 - f. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - g. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
 - h. B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
 - i. B139/B139, Standard Specification for Phosphor Bronze Rod, Bar and Shapes.
 - j. B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
 - k. B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
 - l. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.

GRFF OZONE SYSTEM REPLACEMENT

- m. D429, Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.
- n. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
- 4. Canadian Standards Association, Inc. (CSA): 9.1, Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.
- 5. Chlorine Institute (CI): Pamphlet 6, Piping Systems for Dry Chlorine.
- 6. FM Global (FM).
- 7. Food and Drug Administration (FDA).
- 8. International Association of Plumbing and Mechanical Officials (IAPMO).
- 9. Manufacturers Standardization Society (MSS):
 - a. SP-80, Bronze Gate, Globe, Angle, and Check Valves.
 - b. SP-81, Stainless Steel, Bonnetless, Flanged Knife Gate Valves.
 - c. SP-85, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.
 - d. SP-88, Diaphragm Valves.
 - e. SP-110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- 10. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- 11. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
- 12. UL.
- 13. USC Foundation for Cross-Connection Control and Hydraulic Research.

1.02 SUBMITTALS

A. Action Submittals:

- 1. Shop Drawings:
 - a. Product data sheets for each make and model. Indicate valve Type Number, applicable Tag Number, and facility name/number or service where used.
 - b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
 - c. Certification for compliance to NSF/ANSI 61 for valves used for drinking water service.
 - d. Power and control wiring diagrams, including terminals and numbers.

- e. For each power actuator provided, manufacturer's standard data sheet, with application specific features and options clearly identified.
- f. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

- 1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
- 2. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for:
 - a. Electric actuators; full compliance with AWWA C542.
 - b. Butterfly valves; full compliance with AWWA C504.
- 3. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
- 4. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

PART 2 PRODUCTS

2.01 GENERAL

- A. Valves to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, operating nut, chain, wrench, and accessories to allow a complete operation from the intended operating level.
- B. Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.
- C. Valve same size as adjoining pipe, unless otherwise called out on the Drawings or in Supplements.
- D. Valve ends to suit adjacent piping.
- E. Resilient seated valves shall have no leakage (drip-tight) in either direction at valve rated design pressure. All other valves shall have no leakage (drip-tight) in either direction at valve rated design pressure, unless otherwise allowed for in this section or in stated valve standard.
- F. Size operators and actuators to operate valve for full range of pressures and velocities.
- G. Valve to open by turning counterclockwise, unless otherwise specified.
- H. Factory mount operator, actuator, and accessories.

GRFF OZONE SYSTEM REPLACEMENT

- I. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 SCHEDULE

- A. Additional requirements relative to this section are shown on Valve Schedule located at the end of this section.

2.03 MATERIALS

- A. Bronze and brass valve components and accessories that have surfaces in contact with water to be alloys containing less than 16 percent zinc and 2 percent aluminum.
 1. Approved alloys are of the following ASTM designations: B61, B62, B98/B98M (Alloy UNS No. C65100, C65500, or C66100), B139/B139M (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.
 2. Stainless steel Alloy 18-8 may be substituted for bronze.
- B. Valve materials in contact with or intended for drinking water service to meet the following requirements:
 1. Materials to comply with requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements.
 2. Coatings materials to be formulated from materials deemed acceptable to NSF/ANSI 61.

2.04 FACTORY FINISHING

- A. General:
 1. Interior coatings for valves and hydrants shall be in accordance with AWWA C550, unless otherwise specified.
 2. Exterior coating for valves and hydrants shall be in accordance with manufacturer's standard, color to match existing paint color.
 3. Material in contact with potable water shall conform to NSF/ANSI 61.

- B. Where epoxy lining and coating are specified, factory finishing shall be as follows:
 - 1. In accordance with AWWA C550.
 - 2. Either two-part liquid material or heat-activated (fusion) material except only heat-activated material if specified as “fusion” or “fusion bonded” epoxy.
 - 3. Minimum 7-mil dry film thickness except where limited by valve operating tolerances.

2.05 VALVES

- A. All valves greater than 2 inches in size shall be supplied with an identification tag. Tags shall be 2-inch square or circular aluminum or 1/16-inch-thick fiberglass.
- B. All automatically operated valve actuators shall be provided with a mechanical adjustment to limit the rate of change for opening and closing the valve.
- C. Globe Valves:
 - 1. Type V207 Needle Disc Type Globe Valve 1/4-inch to 3/4-inch:
 - a. Type 316 stainless steel, threaded bonnet, rising stem, rated 200 pounds per square inch SWP/400 pounds per square inch CWP minimum.
 - b. Manufacturers and Products:
 - 1) Swagelok; PD.
 - 2) Conbraco Apollo; 60A.
- D. Ball Valves:
 - 1. Type V306 Stainless Steel Ball Valve 2 Inches and Smaller:
 - a. ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel cast body and end piece, full port ASTM A276 Type 316 stainless steel ball, NPT threaded ends, reinforced PTFE seats, PTFE seals, and packing, adjustable packing gland, blowout proof stainless steel stem, stainless steel lever operator with vinyl grip, rated 1,000 pounds per square inch gauge. CWP, complies with MSS SP-110.
 - b. See Paragraph Isolation Valves for LOX Service in this article for additional LOX service requirements.
 - c. Manufacturers and Products:
 - 1) Sharpe; 58876.
 - 2) Conbraco Apollo; 76-100 Series.
 - 3) Nibco; T-585-S6-R-66-LL.

GRFF OZONE SYSTEM REPLACEMENT

2. Type V307 Stainless Steel Ball Valve 1 Inches to 3 Inches:
 - a. Two-piece, full port, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body and end piece, full port ASTM A276 Type 316 stainless steel ball, flanged ends, reinforced PTFE seats, PTFE seals, and packing, adjustable packing gland, blowout proof stainless steel stem, stainless steel lever operator with vinyl grip, rated 1,000 pounds per square inch CWP, complies with MSS SP-110. Oxygen cleaned and suitable for Ozone/Oxygen service.
 - b. See 2.05.C for additional LOX service requirements
 - c. Manufacturers and Products:
 - 1) Sharpe; 50116.
 - 2) Conbraco Apollo; 76F-100 Series.
 - 3) Nibco; T-585-S6-R-66-LL.
 3. Type V330 PVC Ball Valve 2 Inches and Smaller:
 - a. Rated 150 pounds per square inch at 73 degrees F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, ball, and stem, end entry, double union design, solvent-weld socket ends, elastomer seat, Viton or Teflon O-ring stem seals, to block flow in both directions. Provide pressure relief hole drilled on low pressure side of ball.
 - b. Manufacturers and Products:
 - 1) Nibco; Chemtrol Tru-Bloc.
 - 2) ASAHI/America; Type 21.
 - 3) Spears; True Union.
- E. Isolation Valves for LOX Service: Valves shall be globe or ball style valves. Ball valves shall have appropriate upstream vent-tap on ball to prevent trapping of LOX or GOX fluid. Valve bodies, bonnets, and plugs shall be brass or bronze or stainless steel, with stainless steel stems and PTFE or other approved packing for the intended fluid application. Valves in use in LOX piping and on LOX service shall be suitable for cryogenic use and shall have extended stems. All valves shall be cleaned for oxygen service. Valves shall be as manufactured by The Wm. Powell Company, Goddard Valve Corporation, "or-equal."
- F. Butterfly Valves:
1. General:
 - a. In full compliance with AWWA C504 and following requirements:
 - 1) Suitable for throttling operations and infrequent operation after periods of inactivity.

GRFF OZONE SYSTEM REPLACEMENT

- 2) Elastomer seats which are bonded or vulcanized to the body shall have adhesive integrity of bond between seat and body assured by testing, with minimum 75-pound pull in accordance with ASTM D429, Method B.
- 3) Bubble-tight with rated pressure applied from either side. Test valves with pressure applied in both directions.
- 4) No travel stops for disc on interior of body.
- 5) Self-adjusting V-type or O-ring shaft seals.
- 6) Isolate metal-to-metal thrust bearing surfaces from flowstream.
- 7) Provide traveling nut or worm gear actuator with handwheel. Valve actuators to meet the requirements of AWWA C504.
- 8) Buried service operators shall withstand 450-foot-pounds of input torque at fully open and fully closed positions.
- 9) Provide linings and coatings per AWWA, unless otherwise indicated on the Drawings or specified herein.
- 10) Valves to be in full compliance with NSF/ANSI 61.
- b. Non-AWWA butterfly valves to meet the following actuator requirements:
 - 1) For above ground installations, provide handle and notch plate for valves 6 inches and smaller and heavy-duty, totally enclosed gearbox type operators with handwheel, position indicator and travel stops for valves 8 inches and larger, unless otherwise indicated on the Drawings or specified herein.
2. Type V500 Butterfly Valve for Water Works Service 3 Inches to 72 Inches:
 - a. AWWA C504, Class 150B.
 - b. Short body type, flanged or wafer style ends.
 - c. Cast-iron body, Type 316 stainless steel disc and shaft, Buna-N rubber seat bonded or molded in body only, and stainless steel seating surface.
 - d. Provide epoxy lining in compliance with AWWA C550.
 - e. Manufacturers and Products:
 - 1) Pratt; Model Triton XR-70.
 - 2) DeZurik; AWWA Valve.
3. Type V502 Butterfly Valve for Ozonated Water Service 3 Inches to 72 Inches:
 - a. Short body type, 150 pound flanged or wafer ends.
 - b. high performance type, Type 316 stainless steel body, Type 316 stainless steel single or double offset disc, and Type 316 stainless steel shaft and taper pins, PTFE seat.

GRFF OZONE SYSTEM REPLACEMENT

c. Manufacturers and Products:

- 1) Keystone; F221-786.
- 2) Flowseal.
- 3) "Or-equal."

G. Check and Flap Valves:

1. Type V617 Wafer Style Check Valve 2 Inches to 36 Inches:
 - a. Wafer style, swing check, Type 316 stainless steel body, Type 316 stainless steel disc, Type 316 stainless steel spring and other internals, PTFE or stainless steel seal, and internal epoxy coatings.
 - b. Manufacturers and Products:
 - 1) Keystone; Prince Figure 800 Series.
 - 2) Stayflow; SS-SW.
2. Type V619 Double Disc Style Check Valve 2 Inches to 36 Inches:
 - a. Wafer style, double disc swing check, Type 316 stainless steel body, Type 316 stainless steel disc, Type 316 stainless steel spring and other internals, PTFE or stainless steel seal and internal epoxy coatings.
 - b. Manufacturers and Products:
 - 1) Crane CPE; Dou Chek II.
 - 2) Stayflow; DD-SW.
3. Type V627 PVC Ball Check Valve 4 Inches and Smaller:
 - a. ASTM D1784, Type I, Grade 1 polyvinyl chloride body, dual union socket weld ends, rated 150 pounds per square inch at 73 degrees F, and Viton seat and seal.
 - b. Manufacturers and Products:
 - 1) Nibco; Chemtrol Tru Union.
 - 2) ASAHI/America.
 - 3) Spears; True Union.

H. Self-Regulating Valves:

1. Type V720 PVC Pressure Relief, By-Pass Relief, Back-Pressure Regulator, Back-Pressure, Anti-Siphon Valve 1/2-Inch to 2 Inches:
 - a. Direct acting diaphragm, spring controlled, in-line pattern, NPT threaded inlet and outlet, 150 pounds per square inch design pressure.
 - b. PVC body, Teflon or Viton diaphragm, PVC or Teflon piston, high-density polyethylene or stainless steel adjusting bolt and locknut, stainless steel or coated steel spring, stainless steel fasteners.
 - c. Designed to open when upstream pressure reaches setpoint; set pressure adjustable from 10 pounds per square inch to 100 pounds per square inch, minimum.

- d. Manufacturers and Products:
 - 1) Plast-O-Matic; Series RVDT.
 - 2) Griffco; Series BPV.
 - 3) Primary Fluid Systems; TOP Valve.

2.06 OPERATORS AND ACTUATORS

A. Manual Operators:

- 1. General:
 - a. For AWWA valves, operator force not to exceed requirements of applicable valve standard. Provide gear reduction operator when force exceeds requirements.
 - b. For non-AWWA valves, operator force not to exceed applicable industry standard or 80 pounds, whichever is less, under operating condition, including initial breakaway. Provide gear reduction operator when force exceeds requirements.
 - c. Operator self-locking type or equipped with self-locking device.
 - d. Position indicator on quarter-turn valves.
 - e. Worm and gear operators one-piece design, worm-gears of gear bronze material. Worm of hardened alloy steel with thread ground and polished. Traveling nut type operator's threaded steel reach rod with internally threaded bronze or ductile iron nut.
- 2. Exposed Operator:
 - a. Galvanized and painted handwheel.
 - b. Cranks on gear type operator.
 - c. Chain wheel operator with tieback, extension stem, floor stand, and other accessories to permit operation from normal operation level.
 - d. Valve handles to take a padlock, and wheels a chain and padlock.

B. Electric Operators, 120 Volts:

- 1. General:
 - a. Unit shall be low profile to reduce amount of required space and weigh 15 pounds or less.
 - b. Size to 1-1/2 times required operating torque. Motor stall torque not to exceed torque capacity of the valve.
 - c. Provide operator mounting bracket to mount operator to valve providing minimal torque to piping system when operating.
- 2. Operator Operation, General:
 - a. Suitable for full 90-degree rotation of quarter-turn valves.
 - b. Manually override handwheel.
 - c. Mechanical valve position indication.

GRFF OZONE SYSTEM REPLACEMENT

3. Electronic Control:
 - a. Torque Limiting Switches: Two single pole, double throw mechanical switches. Switches operate at any point in valve travel.
 - b. Jammed-valve detection and protection.
 - c. Motor over-temperature detection and protection.
 - d. Travel limit switches, single pole double throw.
4. Open-Close (O/C) Service:
 - a. Duty cycle for intermittent ON-OFF operation shall be 25 percent.
 - b. Operator shall power to OPEN and power to CLOSE.
 - c. Local Indication and Control:
 - 1) Integral mechanical valve POSITION indication, 0 percent to 100 percent OPENED.
 - 2) Integral OPENED and CLOSED indication lights.
 - 3) Integral LOCAL-OFF-REMOTE (L-O-R).
 - 4) Integral OPEN maintained switch which causes the valve to stroke full OPENED, even if OPEN switch is released, while L-O-R switch is in LOCAL.
 - 5) Integral CLOSE maintained switch which causes valve to stroke full CLOSED, even if CLOSED switch is released, while L-O-R switch is in LOCAL.
 - d. Remote Indication and Control:
 - 1) Relay contact that closes when valve is capable of being controlled remotely (L-O-R switch in REMOTE) for connection to and monitoring by plant control system.
 - 2) Limit switch that closes when valve is fully OPENED for connection to and monitoring by plant control system.
 - 3) Limit switch that closes when valve is fully CLOSED for connection to and monitoring by plant control system.
 - e. Modulating (M) Service:
 - 1) Operator rated for continuous duty with servo shall be rated for 100 percent modulating operation.
 - 2) Operator shall modulate based on an externally applied 4 mA dc to 20 mA dc signal.
 - 3) Operator shall be equipped with an electronic servo module for valve modulation: Module shall provide serial communications with provided cable for setup of valve operation.
 - f. Local Indication and Control:
 - 1) Integral mechanical valve POSITION indication, 0 percent to 100 percent OPENED.
 - 2) Integral OPENED and CLOSED indication lights.
 - 3) Integral LOCAL-OFF-REMOTE (L-O-R).

- 4) Integral OPEN momentary switch which causes valve to stroke towards OPENED, as long as OPEN switch is held, while L-O-R switch is in LOCAL.
- 5) Integral CLOSE momentary switch which causes valve to stroke towards CLOSED, as long as CLOSED switch is held, while L-O-R switch is in LOCAL.
- 6) Position valve proportionally 0 percent to 100 percent OPEN with external 4 mA to 20 mA dc signal while in REMOTE.
- g. Remote Indication and Control:
 - 1) Relay contact that closes when valve is capable of being controlled remotely (L-O-R switch in REMOTE) for connection to and monitoring by plant control system.
 - 2) Limit switch that closes when valve is fully OPENED for connection to and monitoring by plant control system.
 - 3) Limit switch that closes when valve is fully CLOSED for connection to and monitoring by plant control system.
 - 4) Current Position Transmitter, 4 mA to 20 mA dc signal in proportion to 0 percent to 100 percent OPENED, with 0.5 percent accuracy and 0.5 percent repeatability, capable of driving a 750-ohm load, for connection to and monitoring by Plant Control System.
5. Control Features: Electric motor actuators with features as noted above, and as modified/supplemented in Electric Actuated Valve Schedule.
6. Manufacturer: Rotork.

2.07 VALVE ACCESSORIES

- A. Tagging: 1-1/2-inch diameter stainless steel tag attached with No. 16 solid brass or stainless steel jack chain for each valve.
- B. Limit Switch: Factory installed NEMA 4X limit switch by actuator manufacturer.
- C. Chain Wheel and Guide:
 1. Handwheel direct-mount type.
 2. Complete with chain.
 3. Galvanized or cadmium-plated.
 4. Manufacturers and Products:
 - a. Clow Corp.; Figure F-5680.
 - b. Walworth Co.; Figure 804.
 - c. DeZurik Corp.; Series W or LWG.

GRFF OZONE SYSTEM REPLACEMENT

D. Indicator Post Assembly:

1. Cast or ductile iron post head, bell, and wrench with cast or ductile iron or steel barrel.
2. Plexiglas or equal protected window to indicate OPEN and CLOSED position.
3. Padlockable eye bolt for wrench.
4. Adjustable bury depth. Bury depth as required for valve installation.
5. UL Listed and FM Approved.
6. Manufacturers and Products:
 - a. Clow; Style 2945.
 - b. Mueller; A-20806.

2.08 AUTOMATIC BRUSH FILTERS

- A. Automatic cleaning basket strainer with Carbon steel housing, 4-inch flanged inlet and outlet connection, stainless steel screen element with 1,500 μ m perforations. 120V latching solenoid flushing valve. Motorized rotary brush frame for screen cleaning. Self-lubricating bearing. EPDM gaskets.
- B. Controller within NEMA 4X Enclosure, and differential pressure switch.
- C. Manufacturers and Products: Amiad; MAP 100.

2.09 HEAT EXCHANGER

- A. Modification to existing equipment, Tag No.: M31361 and M31362.
- B. Add additional plate to increase plate and frame heat exchanger capacity to 740,000 BTU/hr. Match existing materials: Alloy 316 Plates, NBRB gaskets, and Mild steel frame.
- C. Materials to clean and flush existing heat exchanger plates according to manufacturer specifications.
- D. Manufacturers and Products: Alpha Laval; M10B.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Flange Ends:
 1. Flanged valve bolt holes shall straddle vertical centerline of pipe.
 2. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

B. Screwed Ends:

1. Clean threads by wire brushing or swabbing.
2. Apply joint compound.

C. PVC and CPVC Valves: Install using solvents approved for valve service conditions.

D. Valve Installation and Orientation:

1. General:
 - a. Install valves so handles operate from fully open to fully closed without encountering obstructions.
 - b. Install valves in location for easy access for routine operation and maintenance.
 - c. Install valves per manufacturer's recommendations.
2. Gate, Globe, and Ball Valves:
 - a. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.
 - b. Install operating stem horizontal in horizontal runs of pipe having centerline elevations greater than 4 feet 6 inches above finish floor, unless otherwise shown.
3. Butterfly Valves:
 - a. Unless otherwise restricted or shown on the Drawings, install valve a minimum of 8 diameters downstream of a horizontal elbow or branch tee with shaft in horizontal position.
 - b. For vertical elbow or branch tee immediately upstream of valve, install valve with shaft in vertical position.
 - c. For horizontal elbow or branch tee immediately upstream of valve, install valve with shaft in horizontal position.
 - d. When installed immediately downstream of swing check, install valve with shaft perpendicular to swing check shaft.
 - e. For free inlet or discharge into basins and tanks, install valve with shaft in vertical position.
4. Check Valves:
 - a. Install valve in accordance with manufacturer's instructions and provide required distance from immediate upstream fitting.
 - b. Install valve in vertical flow (up) piping only for gas services.
 - c. Install swing check valve with shaft in horizontal position.
 - d. Install double disc swing check valve to be perpendicular to flow pattern when discs are open.
5. Solenoid Valves: Install in accordance with manufacturer's instructions.

GRFF OZONE SYSTEM REPLACEMENT

- E. Install line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.
- F. Chain Wheel and Guide: Install chain wheel and guide assemblies or chain lever assemblies on manually operated valves over 6 feet 9 inches above finish floor. Install chain to within 3 feet of finish floor. Where chains hang in normally traveled areas, use appropriate "L" type tie-back anchors. Install chains to within operator horizontal reach of 2 feet 6 inches maximum, measured from normal operator standing location or station.
- G. Heat Exchanger: Install additional plates on existing heat exchanger on cooling water skid. Protect in place adjacent skid mounted equipment and piping. Clean existing heat exchanger plates following manufacturer guidelines.

3.02 TESTS AND INSPECTION

- A. Valve may be either tested while testing pipelines, or as a separate step.
- B. Test that valves open and close smoothly under operating pressure conditions. Test that two-way valves open and close smoothly under operating pressure conditions from both directions.
- C. Count and record number of turns to open and close valve; account for discrepancies with manufacturer's data.
- D. Set, verify, and record set pressures for relief and regulating valves.
- E. Automatic valves to be tested in conjunction with control system testing. Set opening and closing speeds, limit switches, as required or recommended by Engineer.

3.03 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are a part of this specification:
 - 1. Electric Valve and Actuator Schedule.
 - 2. Manual Valve Schedule.
 - 3. Self-Registered Valve Schedule.

END OF SECTION

GRFF OZONE SYSTEM REPLACEMENT

Electric Valve and Actuator Schedule							
Tag Number	Valve Type – [Existing Model]	Valve Size	Actuator Power Supply	Process Fluid	Service	Actuator Model	Control Feature Modifications/ Supplements
ACT-35121 for FV-35121	Ball Valve – [Worcester C4411PMSE]	1-1/2"	480V ac / 60-Hz	LOX	O/C	Rotork IQT125	C, D, E, F, G
ACT-35122 for FV-35122	Ball Valve – [Worcester C4411PMSE]	1-1/2"	480V ac / 60-Hz	LOX	O/C	Rotork IQT125	C, D, E, F, G
ACT-35221 A for FV-35221A	Ball Valve – [Sharpe 50116]	4"	120V ac / 60-Hz	Oxygen	O/C	Rotork IQT250	B, D, E, F, G
ACT-35221 B for FV-35221B	Ball Valve – [Sharpe 50116]	4"	120V ac / 60-Hz	Oxygen	O/C	Rotork IQT250	B, D, E, F, G
ACT-35311 for FV-35311	Butterfly Valve – [Keystone F362-159]	4"	480V ac / 60-Hz	Oxygen	O/C	Rotork IQT125	C, D, E, F, G
PCV-31111♦†	V-Ball Valve – [Fisher V200]	3"	480V ac / 60-Hz	Oxygen/Ozone	M	Rotork IQTM250	C, D, E, F, G
PCV-31112♦†	V-Ball Valve – [Fisher V200]	3"	480V ac / 60-Hz	Oxygen/Ozone	M	Rotork IQTM250	C, D, E, F, G
ACT-31191 for FV-31191	Butterfly Valve – [Keystone F362-159]	3"	480V ac / 60-Hz	Oxygen/Ozone	O/C	Rotork IQT125	C, D, E, F, G
ACT-31192 for FV-31192	Butterfly Valve – [Keystone F362-159]	3"	480V ac / 60-Hz	Oxygen/Ozone	O/C	Rotork IQT125	C, D, E, F, G

GRFF OZONE SYSTEM REPLACEMENT

Electric Valve and Actuator Schedule							
Tag Number	Valve Type – [Existing Model]	Valve Size	Actuator Power Supply	Process Fluid	Service	Actuator Model	Control Feature Modifications/ Supplements
ACT-31211 for FV-31211	Butterfly Valve – [Keystone F222-786]	4"	480V ac / 60-Hz	Closed Loop Cooling Water	O/C	Rotork IQT125	C, D, E, F, G
ACT-31212 for FV-31212	Butterfly Valve – [Keystone F222-786]	4"	480V ac / 60-Hz	Closed Loop Cooling Water	O/C	Rotork IQT125	C, D, E, F, G
FV-31551 [†]	Solenoid Valve – [Clark Cooper EV-16K44- A120-TPST- 001]	1"	120V ac / 60-Hz	Air	O/C	Clark Cooper	B
FCV-32111 ^{♦†}	V-Ball Valve – [Fisher V200]	1-1/2"	480V ac / 60-Hz	Oxygen/Ozone	M	Rotork IQT125	C, D, E, F, G
ACT-32141A for FV-32141A	Butterfly Valve – [Keystone F362-159]	6"	480 V ac / 60-Hz	Water-Ozone	O/C	Rotork IQT125	C, D, E, F, G
ACT-32141B for FV-32141B	Ball Valve – [Sharpe 50116]	3"	480V ac / 60-Hz	Oxygen/Ozone	O/C	Rotork IQT125	C, D, E, F, G
ACT-32142A for FV-32142A	Butterfly Valve – [Keystone F362-159]	6"	480V ac / 60-Hz	Water-Ozone	O/C	Rotork IQT125	C, D, E, F, G
ACT-32142B for FV-32142B	Ball Valve – [Sharpe 50116]	3"	480V ac / 60-Hz	Oxygen/Ozone	O/C	Rotork IQT125	C, D, E, F, G

GRFF OZONE SYSTEM REPLACEMENT

Electric Valve and Actuator Schedule							
Tag Number	Valve Type – [Existing Model]	Valve Size	Actuator Power Supply	Process Fluid	Service	Actuator Model	Control Feature Modifications/ Supplements
FCV-32511♦†	V-Ball Valve – [Fisher V200]	1-1/2"	480V ac / 60-Hz	Oxygen/Ozone	M	Rotork IQT125	C, D, E, F, G
ACT-32541A for FV-32541A	Butterfly Valve – [Keystone F362-159]	6"	480V ac / 60-Hz	Water-Ozone	O/C	Rotork IQT125	C, D, E, F, G
ACT-32541B for FV-32541B	Ball Valve – [Sharpe 50116]	3"	480V ac / 60-Hz	Oxygen/Ozone	O/C	Rotork IQT125	C, D, E, F, G
ACT-32542A for FV-32542A	Butterfly Valve – [Keystone F362-159]	6"	480V ac / 60-Hz	Water-Ozone	O/C	Rotork IQT125	C, D, E, F, G
ACT-32542B for FV-32542B	Ball Valve – [Sharpe 50116]	3"	480V ac / 60-Hz	Oxygen/Ozone	O/C	Rotork IQT125	C, D, E, F, G
ACT-33211♦ for FCV-33211	Butterfly Valve – [Keystone F362-159]	3"	480V ac / 60-Hz	Oxygen/Ozone	M	Rotork IQT125	C, D, E, F, G
ACT-33212♦ for FCV-33212	Butterfly Valve – [Keystone F362-159]	3"	480V ac / 60-Hz	Oxygen/Ozone	M	Rotork IQT125	C, D, E, F, G
FV-33221♦†	Solenoid Valve – [Clark Cooper EV-16K44- A120-TPST- 001]	1"	120V ac / 60-Hz	Oxygen/Ozone	O/C	Clark Cooper	B

GRFF OZONE SYSTEM REPLACEMENT

Electric Valve and Actuator Schedule							
Tag Number	Valve Type – [Existing Model]	Valve Size	Actuator Power Supply	Process Fluid	Service	Actuator Model	Control Feature Modifications/ Supplements
FV-33222♦†	Solenoid Valve – [Clark Cooper EV-16K44- A120-TPST- 001]	1"	120V ac / 60-Hz	Oxygen/Ozone	O/C	Clark Cooper	B
Tag Number: ACT is actuator only for the associated valve with the same tag number Service: O/C = Open-Close, T = Throttling, M = Modulating Control Feature Modifications/Supplements: A = Actuator shall open valve upon loss of signal. B = Actuator shall close valve upon loss of signal. C = Actuator shall remain in last position upon loss of signal. D = Local OPEN-CLOSE momentary pushbuttons that must be continuously depressed to initiate/maintain valve travel; travel stops when pushbutton is released or when end of travel limit is reached. E = Remote OPEN-CLOSE maintained dry contacts; travel stops when remote contact opens, or when end of travel limit is reached. F = Open/Close Limit Switches G = Local Disconnect Switch. ♦Ozone System Supplier Scope †Cleaned for Oxygen Service							

GRFF OZONE SYSTEM REPLACEMENT

Manual Valve Schedule				
Tag Number	Valve Type	Size (inches)	Fluid	Notes
BLV-26221	V330	1/2"	Sodium Bisulfite	
BLV-26222	V330	1/2"	Sodium Bisulfite	
BLV-26223	V330	1/2"	Sodium Bisulfite	
BLV-26224	V330	1/2"	Sodium Bisulfite	
BFV-31301B	V500	4"	Cooling Water	See Note 1
BFV-31301C	V500	4"	Cooling Water	See Note 1
BFV-31301D	V500	4"	Cooling Water	See Note 1
BLV-31301E	V306	1/2"	Cooling Water	
BLV-31301F	V306	1/2"	Cooling Water	
BLV-31301H	V306	1/2"	Cooling Water	
BLV-31301I	V306	1/2"	Cooling Water	
CV-31301	V617	1-1/2"	Cooling Water	
BFV-31302B	V500	4"	Cooling Water	See Note 1
BFV-31302C	V500	4"	Cooling Water	See Note 1
BFV-31302D	V500	4"	Cooling Water	See Note 1
BLV-31302E	V306	1/2"	Cooling Water	
BLV-31302F	V306	1/2"	Cooling Water	
BLV-31302H	V306	1/2"	Cooling Water	
BLV-31302I	V306	1/2"	Cooling Water	
CV-31302	V617	1-1/2"	Cooling Water	
BFV-31311A	V500	4"	Cooling Water	See Note 1

GRFF OZONE SYSTEM REPLACEMENT

Manual Valve Schedule				
Tag Number	Valve Type	Size (inches)	Fluid	Notes
BFV-31312A	V500	4"	Cooling Water	See Note 1
BFV-31313A	V500	4"	Cooling Water	See Note 1
BLV-31521A	V306	1/2"	Air	
BLV-32111B	V307	3"	Ozone / Oxygen	Cleaned for Oxygen Service
BLV-32111C	V307	3"	Ozone / Oxygen	Cleaned for Oxygen Service
BLV-32111D	V307	3"	Ozone / Oxygen	Cleaned for Oxygen Service
BFV-32133A	V500	6"	Dilution Water	See Note 1
CV-32133B	V617	6"	Dilution Water	
BFV-32133C	V500	6"	Dilution Water	See Note 1
BFV-32133D	V500	6"	Dilution Water	See Note 1
CV-32141H	V619	3"	Ozone / Oxygen	Cleaned for Oxygen Service
BLV-32141I	V306	1/2"	Drain	Cleaned for Oxygen Service
BLV-32141J	V306	1/2"	Ozone / Oxygen	Cleaned for Oxygen Service
CV-32142H	V619	3"	Ozone / Oxygen	Cleaned for Oxygen Service
BLV-32142I	V306	1/2"	Drain	Cleaned for Oxygen Service
BLV-32142J	V306	1/2"	Ozone / Oxygen	Cleaned for Oxygen Service
BLV-32511B	V307	3"	Ozone / Oxygen	Cleaned for Oxygen Service
BLV-32511C	V307	3"	Ozone / Oxygen	Cleaned for Oxygen Service
BLV-32511D	V307	3"	Ozone / Oxygen	Cleaned for Oxygen Service
BFV-32531D	V500	6"	Dilution Water	See Note 1
BFV-32533A	V500	6"	Dilution Water	See Note 1

GRFF OZONE SYSTEM REPLACEMENT

Manual Valve Schedule				
Tag Number	Valve Type	Size (inches)	Fluid	Notes
CV-32533B	V617	6"	Dilution Water	
BFV-32533C	V500	6"	Dilution Water	See Note 1
BFV-32533D	V500	6"	Dilution Water	See Note 1
CV-32541H	V619	3"	Ozone / Oxygen	Cleaned for Oxygen Service
BLV-32541I	V306	1/2"	Drain	Cleaned for Oxygen Service
BLV-32541J	V306	1/2"	Ozone / Oxygen	Cleaned for Oxygen Service
CV-32542H	V619	3"	Ozone / Oxygen	Cleaned for Oxygen Service
BLV-32542I	V306	1/2"	Drain	Cleaned for Oxygen Service
BLV-32542J	V306	1/2"	Ozone / Oxygen	Cleaned for Oxygen Service
BLV-33251A	V306	1/2"	Ozone / Oxygen	Cleaned for Oxygen Service
BLV-33251B	V306	1/2"	Ozone / Oxygen	Cleaned for Oxygen Service
BLV-33252A	V306	1/2"	Ozone / Oxygen	Cleaned for Oxygen Service
BLV-33252B	V306	1/2"	Ozone / Oxygen	Cleaned for Oxygen Service
BLV-35111A	V306	1/2"	LOX	Cleaned for Oxygen Service
BLV-35111C	V306	1/2"	LOX	Cleaned for Oxygen Service
BLV-35112A	V306	1/2"	LOX	Cleaned for Oxygen Service
BLV-35112C	V306	1/2"	LOX	Cleaned for Oxygen Service
BLV-35531	V306	1/2"	Ozone / Oxygen	Cleaned for Oxygen Service
NV-36131A	V207	1/2"	Sample	
NV-36531A	V207	1/2"	Sample	
NV-36132A	V207	1/2"	Sample	

GRFF OZONE SYSTEM REPLACEMENT

Manual Valve Schedule				
Tag Number	Valve Type	Size (inches)	Fluid	Notes
NV-36532A	V207	1/2"	Sample	
NV-36133A	V207	1/2"	Sample	
NV-36533A	V207	1/2"	Sample	
NV-36134A	V207	1/2"	Sample	
NV-36534A	V207	1/2"	Sample	
Note 1: V500 Linings: <u>System No. 1</u> ; Coating: <u>System No. 4</u> as described in Section 09 90 00, Painting and Coating.				

Self-Regulated Valve Schedule						
Tag No.	Valve Type No.	Size (inches)	Pressure Setpoint*	Maximum psig	Flow (gpm)	Fluid
PSV-26221	V720	1/2"	100 psig	135 psig	45	SBS
PSV-26222	V720	1/2"	100 psig	135 psig	45	SBS
PSV-26223	V720	1/2"	100 psig	135 psig	45	SBS
PSV-26224	V720	1/2"	100 psig	135 psig	45	SBS
PCV-26231	V720	1/2"	50 psig	100 psig	45	SBS
PCV-26232	V720	1/2"	50 psig	100 psig	45	SBS
*Pressure Setpoint = Release pressure for Safety Relief Valve (PSV) or inlet pressure for back pressure regulating valve (PCV) SBS = Sodium Bisulfite						

SECTION 40 42 13
PROCESS PIPING INSULATION

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Society of Heating, Refrigerating and Air Conditioning Engineers Inc. (ASHRAE): 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 2. ASTM International (ASTM):
 - a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - b. C165, Standard Test Method for Measuring Compressive Properties of Thermal Insulations.
 - c. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
 - d. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - e. C534/C534M, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - f. C547, Standard Specification for Mineral Fiber Pipe Insulation.
 - g. C552, Standard Specification for Cellular Glass Thermal Insulation.
 - h. C585, Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.
 - i. C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
 - j. C1729, Standard Specification for Aluminum Jacketing for Insulation.
 - k. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - l. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.
 3. International Code Council (ICC): International Energy Conservation Code (IECC).
 4. UL.

GRFF OZONE SYSTEM REPLACEMENT

1.02 SUBMITTALS

- A. Action Submittals: Manufacturer's descriptive literature.
- B. Informational Submittals: Maintenance information.

PART 2 PRODUCTS

2.01 PIPE AND FITTING INSULATION

- A. Type 1—Elastomeric:
 - 1. Material: Flexible elastomeric pipe insulation, closed-cell structure in accordance with ASTM C534/C534M.
 - 2. Temperature Rating: Minus 297 degrees F to 220 degrees F.
 - 3. Nominal Density: 3 pcf to 6 pcf.
 - 4. Conductivity in accordance with ASHRAE 90.1 and maximum numerical value of 0.25 Btu-in./hr-square foot degrees F at 75 degrees F per ASTM C177 or ASTM C518.
 - 5. Maximum water vapor transmission of 0.06-perm-inch per ASTM E96/E96M, Procedure A.
 - 6. Joints: Manufacturer's adhesive.
 - 7. Flame Spread Rating: Less than 25 per ASTM E84.
 - 8. Smoke Developed Index: Less than 50 per ASTM E84.
 - 9. Manufacturers and Products:
 - a. Nomaco; K-Flex.
 - b. Armacell; AP Armaflex.
- B. Type 3—Foamglass:
 - 1. Material: Cellular glass per ASTM C552.
 - 2. Nominal Density: 7.5 pcf.
 - 3. Compressive Strength: 90 pounds per square inch per ASTM C165.
 - 4. Temperature Rating: Minus 450 degrees F to 900 degrees F.
 - 5. Conductivity in accordance with ASHRAE 90.1 and maximum numerical value of 0.29 Btu-in./hr-square foot degrees F.
 - 6. Minimum water vapor transmission for insulation of 0.00-perm-inch per ASTM E96/E96M.
 - 7. Joints: Matching pressure-sensitive butt strips for sealing circumferential joints.
 - 8. Flame Spread Rating: 0 per ASTM E84.
 - 9. Smoke Developed Index: 0 per ASTM E84.
 - 10. Follow manufacturer's recommendation, based upon temperature of piping to be insulated.
 - 11. Manufacturer and Product: Pittsburgh Corning; Foamglass One.

2.02 INSULATION AT PIPE HANGERS AND SUPPORTS

- A. Refer to Section 40 05 15, Piping Support Systems.
- B. Copper, Ductile Iron, and Nonmetallic Pipe: High-density insert, thickness equal to adjoining insulation of Type 3 or other rigid insulation or manufactured pre-insulated pipe hanger and insulation shield. Extend insert beyond shield.
- C. Steel Pipe: Insulation saddle or high-density insert, thickness equal to adjoining insulation of Type 3 or other rigid insulation or manufactured pre-insulated pipe hanger and insulation shield at support location. Extend insert beyond shield.

2.03 INSULATION FINISH SYSTEMS

- A. Type F1—PVC:
 - 1. Polyvinyl chloride (PVC) jacketing, minimum 20 mils indoors and 30 mils outdoors, for straight run piping and fitting locations, temperatures to 140 degrees F.
 - 2. Color: PVC jacketing shall be color coded to match colors listed in pipe schedule where suitable matching colors are available. If no suitable colors are available jacketing shall be white.
 - 3. Flame Spread Rating: 25 per ASTM E84.
 - 4. Smoke Developed Index: 50 per ASTM E84.
 - 5. Manufacturers and Products:
 - a. Knauf Insulation; Proto 1000.
 - b. Johns Manville; Zeston 2000 or 300.
 - c. Speedline; 25/50 Smoke-Safe.
- B. Type F3—Aluminum:
 - 1. Aluminum Roll Jacketing: For straight run piping, wrought aluminum Alloy 3003, Alloy 5005, Alloy 1100, or Alloy 3105 to ASTM B209 with H-14 temper, in accordance with ASTM C1729, minimum 0.016-inch thickness, with smooth mill finish.
 - 2. Vapor Barrier: Provide factory applied vapor barrier, heat and pressure bonded to inner surface of aluminum jacketing.
 - 3. Fitting Covers: Material as for aluminum roll jacketing, premolded, one or two piece covers, which includes elbows, tee/valves, end caps, mechanical line couplings, and specialty fittings.
 - 4. Manufacturers:
 - a. RPR Products; Insul-Mate.
 - b. ITW, Pabco-Childers.

GRFF OZONE SYSTEM REPLACEMENT

C. Type F4—Foamglass Jacketing:

1. Type 3 Insulation—Buried and Up to 1-Foot Above Grade: 70-mil bituminous resin with woven, glass fabric, aluminum foil layer, and plastic film coating, self-sealing manual pressure seals; Pittsburgh Corning Pittwrap SS.
2. Type 3 Insulation—Greater than 1 Foot Above Grade: 30-mil modified bituminous membrane with self-sealing manual pressure seals; Pittsburgh Corning Pittwrap CW30.

PART 3 EXECUTION

3.01 APPLICATION

A. General:

1. Insulate valve bodies, flanges, and pipe couplings.
2. Insulate and vapor seal hangers, supports, anchors, and other piping appurtenances that are secured directly to cold surfaces.
3. Do not insulate flexible pipe couplings and expansion joints.
4. Service and Insulation Thickness: Refer to Supplement Service and Insulation Thickness table following “End of Section” and to Piping Schedule in Section 40 27 00, Process Piping—General.

3.02 INSTALLATION

A. General:

1. Install in accordance with manufacturer’s instructions and as specified herein.
2. Install after piping system has been pressure tested and leaks corrected.
3. Install over clean dry surfaces.
4. Use insulating cements, lagging adhesives, and weatherproof mastics recommended by insulation manufacturer.
5. Do not allow insulation to cover nameplates or code inspection stamps.
6. Run insulation or insulation inserts continuously through pipe hangers and supports, wall openings, ceiling openings, and pipe sleeves, unless otherwise shown.
7. Install removable insulation sections on devices that require access for maintenance of equipment or removal, such as unions and strainer end plates.
8. Personnel Protection: Install on pipes from floor to 8 feet high. Install on pipes within 4 feet of platforms and to 8 feet high above platforms.

- B. Connection to Existing Piping: Cut back existing insulation to remove portion damaged by piping revisions. Install new insulation.

- C. Cold Surfaces: Provide continuous vapor seal on insulation on cold surfaces where vapor barrier jackets are used.
- D. Placement:
 - 1. Insulate valves and fittings with sleeved or cut pieces of same material.
 - 2. Seal and tape joints.
- E. Vapor Barrier:
 - 1. Provide continuous vapor barrier at joints between rigid insulation and pipe insulation.
 - 2. Install vapor barrier jackets with pipe hangers and supports outside jacket.
 - 3. Do not use staples and screws to secure vapor sealed system components.
- F. Aluminum Jacket:
 - 1. Use continuous friction type joint to hold jacket in place, providing positive weatherproof seal over entire length of jacket.
 - 2. Secure circumferential joints with preformed snap straps containing weatherproof sealant.
 - 3. On exterior piping, apply coating over insulation and vapor barrier to prevent damage when aluminum fitting covers are installed.
 - 4. Do not use screws or rivets to fasten fitting covers.
 - 5. Install removable prefabricated aluminum covers on exterior flanges and unions.
 - 6. Caulk and seal exterior joints to make watertight.

3.03 FIELD FINISHING

- A. Apply coating of insulating cement where needed to obtain smooth and continuous appearance.
- B. Where pipe labels or banding are specified, apply to finished insulation, not to pipe.
- C. Painting Piping Insulation (Exposed to View): Aluminum or color coded PVC jacketing does not require painting.

GRFF OZONE SYSTEM REPLACEMENT

3.04 SUPPLEMENT

A. The supplement listed below, following “End of Section,” is a part of this specification:

1. Service and Insulation Thickness Table.

END OF SECTION

GRFF OZONE SYSTEM REPLACEMENT

Service and Insulation Thickness						
Service Type	Pipe Legend	Thickness	Fluid Temperature (degrees F)*	Insulation	Finish Systems	
					Indoors Exposed	Outdoors
CS–Cooling Systems (Condensate control, chilled water, and refrigerant)	CWR, CWS, GCWR, GCWS	ASHRAE 90.1 or IECC whichever results in the thickest insulation.	40 to 85	Type 1	F3	N/A
Liquid Oxygen	LOX	Pipe Size: Insulation Thickness Inches: * 3/4 & 1.5: 2.5 2 & 2.5: 3.0 3 & 4: 3.5 6 & 8: 4.0	Minus 300 degrees F	Type 3	F3	F3 & F4
*Use these fluid temperatures unless otherwise noted in the Piping Schedule.						

SECTION 40 80 01
PROCESS PIPING LEAKAGE TESTING

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Testing Plan:
 - a. Submit prior to testing and include at least the information that follows.
 - 1) Testing dates.
 - 2) Piping systems and section(s) to be tested.
 - 3) Test type.
 - 4) Method of isolation.
 - 5) Calculation of maximum allowable leakage for piping section(s) to be tested.
2. Certifications of Calibration: Testing equipment.
3. Certified Test Report.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PREPARATION

- A. Notify Engineer in writing 5 days in advance of testing. Perform testing in presence of Engineer.
- B. Pressure Piping:
 1. Install temporary restraint as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.
 2. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.
 3. New Piping Connected to Existing Piping: Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to Engineer.
 4. Items that do not require testing include equipment drains.
 5. Test Pressure: As indicated on Piping Schedule.
- C. Test section may be filled with water and allowed to stand under low pressure prior to testing.

GRFF OZONE SYSTEM REPLACEMENT

3.02 HYDROSTATIC TEST FOR PRESSURE PIPING

- A. Fluid: Clean water of such quality to prevent corrosion of materials in piping system.
- B. Exposed Piping:
 - 1. Perform testing on installed piping prior to application of insulation.
 - 2. Maximum Filling Velocity: 0.25-foot per second, applied over full area of pipe.
 - 3. Vent piping during filling. Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.
 - 4. Maintain hydrostatic test pressure continuously for 30 minutes, minimum, and for such additional time as necessary to conduct examinations for leakage.
 - 5. Examine joints and connections for leakage.
 - 6. Correct visible leakage and retest as specified.
 - 7. Leave pipe full of water after repair of leaks. Empty generator cooling water piping and refill with deionized water.

3.03 PNEUMATIC TEST FOR PRESSURE PIPING

- A. Do not perform on:
 - 1. PVC or CPVC pipe.
 - 2. Piping larger than 18 inches.
 - 3. Buried and other non-exposed piping.
- B. Fluid: Dry oxygen.
- C. Procedure:
 - 1. Apply preliminary pneumatic test pressure of 25 pounds per square inch gauge maximum to piping system prior to final leak testing, to locate visible leaks. Apply soap bubble mixture to joints and connections; examine for leakage.
 - 2. Correct visible leaks and repeat preliminary test until visible leaks are corrected.
 - 3. Gradually increase pressure in system to half of specified test pressure. Thereafter, increase pressure in steps of approximately one-tenth of specified test pressure until required test pressure is reached.
 - 4. Maintain pneumatic test pressure continuously for minimum of 10 minutes and for such additional time as necessary to conduct soap bubble examination for leakage.
 - 5. Correct visible leakage and retest as specified.

- D. Allowable Leakage: Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of leakage.
- E. After testing and final cleaning, purge with nitrogen those lines that will carry flammable gases to assure no explosive mixtures will be present in system during filling process.

3.04 FIELD QUALITY CONTROL

- A. Test Report Documentation:
 - 1. Test date.
 - 2. Description and identification of piping tested.
 - 3. Test fluid.
 - 4. Test pressure.
 - 5. Remarks, including:
 - a. Leaks (type, location).
 - b. Repair/replacement performed to remedy excessive leakage.
 - 6. Signed by Contractor and Owner to represent that test has been satisfactorily completed.

END OF SECTION

**SECTION 40 90 00
INSTRUMENTATION AND CONTROL
FOR PROCESS SYSTEMS**

PART 1 GENERAL

1.01 SUMMARY

- A. This section gives general requirements for Process Instrumentation and Control (PIC). The following PIC subsections expand on requirements of this section:
1. Section 40 91 00, Instrumentation and Control Components.
 2. Part 3 – Veolia Power Supply Unit Procurement Proposal and Control Panel Procurement Proposal, Section 40 99 90, Package Control Systems.
- B. Work Summary: Includes but is not limited to engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up, and training for complete PIC.
1. Removal and salvage of OLM modules in existing Headworks Control Console Cabinet A.
 2. Provision and installation of new Headworks Control Panel CP-11000.
 3. Provision and installation of new Sample Station back panels and removal and salvage of existing sample station back panels.
 4. Provision and programming of Programmable Logic Controllers (PLC), operator interface units (OIU), network switches, and other devices specific to the PIC system.
 5. Removal of Sample Station logic from existing Headworks Control Panel PLCs.
 6. Modification of existing control panel enclosure doors to replace existing operator interface units (OIUs).
 7. Provision and installation of network equipment in existing facility communications and control panels and MCCs.
 8. Testing of panels and assemblies for proper operation prior to shipment from equipment manufacturer's factory.
 9. Testing and commissioning of provided equipment at the treatment plant.
 10. Replacement of the back and side panels in the following existing ozone system control enclosures with new Ozone System Supplier's (OSS) provided back and side panels.
 - a. CP-31000 Ozone Master Control Panel.
 - b. CP-32000 Injection Control Panel.

GRFF OZONE SYSTEM REPLACEMENT

- c. CP-33001 Ozone Destruct Unit 1 Control Panel.
- d. CP-33002 Ozone Destruct Unit 2 Control Panel.
- 11. Provision, installation, configuration and calibration of instruments specified in Section 40 91 00, Instrumentation and Control Components.
- 12. Installation of OSS provided instruments.
- 13. Support for OSS commissioning of the Ozone System Upgrades.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section and other PIC subsections:
 - 1. American National Standards Institute (ANSI).
 - 2. ASTM International (ASTM):
 - a. A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - b. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - c. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - d. B32, Standard Specification for Solder Metal.
 - e. B88, Standard Specification for Seamless Copper Water Tube.
 - 3. Deutsche Industrie-Norm (DIN): VDE 0611, Specification for modular terminal blocks for connection of copper conductors up to 1,000V ac and up to 1,200V dc.
 - 4. Institute of Electrical and Electronics Engineers, Inc. (IEEE): C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 - 5. International Society of Automation (ISA):
 - a. RP12.06.01, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation Part 1: Intrinsic Safety.
 - b. S5.1, Instrumentation Symbols and Identification.
 - c. S5.4, Instrument Loop Diagrams.
 - d. S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments.
 - e. TR20.00.01, Specification Forms for Process Measurement and Control Instruments, Part 1: General.
 - 6. International Conference on Energy Conversion and Application (ICECA).
 - 7. National Electrical Code (NEC).
 - 8. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. ICS 1, Industrial Control and Systems General Requirements.

9. National Fire Protection Association (NFPA): 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
10. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
11. UL: 508A, Standard for Safety, Industrial Control Panels.

1.03 DEFINITIONS

A. Abbreviations:

1. DCU: Distributed Control Unit.
2. FAT: Factory Acceptance Test.
3. FDT: Functional Demonstration Test.
4. HVAC: Heating, Ventilating, and Air Conditioning.
5. I&C: Instrumentation and Control.
6. I/O: Input and Output.
7. OIU: Operator Interface Unit.
8. O&M: Operation and Maintenance.
9. OSS: Ozone System Supplier (Veolia).
10. P&ID: Process and Instrument Diagram.
11. PC: Personal Computer.
12. PIC: Process Instrumentation and Control.
13. PLC: Programmable Logic Controller.
14. RIO: Remote I/O.
15. RTU: Remote Terminal Unit.
16. SCADA: Supervisory Control and Data Acquisition.
17. UPS: Uninterruptible Power Supply.

B. Application Software:

1. Software to provide functions unique to this Project and that are not provided by standard software alone, including but not limited to:
 - a. Configuring databases, tables, displays, historians, reports, parameter lists, ladder logic, function block, and control strategies required to implement functions unique to this Project.
 - b. Programming in any programming or scripting language.

C. Enclosure: Control panel, console, cabinet, or instrument housing.

D. Instructor Day: 8 hours of actual instruction time.

GRFF OZONE SYSTEM REPLACEMENT

- E. This Project differentiates between a Process Instrumentation and Control (PIC) Installer and a PIC Integrator as follows:
1. Contractor's PIC Installer shall perform all physical installation.
 2. Contractor's PIC Integrator shall:
 - a. Be a certified Siemens Solution Provider.
 - b. Design, provide, program, configure, test, deliver, and commission in accordance with the requirements of the design specifications.
 - c. PIC Integrator shall be:
S&B, Inc.
13200 SE 30th St, Suite A
Bellevue, WA 98005
Phone: (425) 644-1700
Email: jstead@sb-inc.com
- F. Rising/Falling: Define action of discrete devices about their setpoint.
1. Rising: Contacts close when an increasing process variable rises through setpoint.
 2. Falling: Contacts close when a decreasing process variable falls through setpoint.
- G. Signal Types:
1. Analog Signal, Current Type:
 - a. 4 mA dc to 20 mA dc signals conforming to ISA S50.1.
 - b. Unless otherwise indicated for specific PIC subsection components, use the following ISA S50.1 options.
 - 1) Transmitter Type: Number 2, two-wire.
 - 2) Transmitter Load Resistance Capacity: Class L.
 - 3) Fully isolated transmitters and receivers.
 2. Analog Signal, Voltage Type: 1V dc to 5V dc within panel where common high precision dropping resistor is used.
 3. Discrete signals, two-state logic signals using dc or 120V ac sources as indicated.
 4. Pulse Frequency Signals:
 - a. Direct-current pulses whose repetition rate is linearly proportional to process variable.
 - b. Pulses generated by contact closures or solid state switches.
 - c. Power source less than 30V dc.
 5. Special Signals: Other types of signals used to transmit analog and digital information between field elements, transmitters, receivers, controllers, and digital devices.

- H. Standard Software: Software packages that are independent of Project on which they are used. Standard software includes system software, supervisory control, and data acquisition (SCADA) software.
1. System Software: Application independent (non-project specific) software developed by digital equipment manufacturers and software companies. Includes, but is not limited to, operating systems; network support, programming languages (C, C++, Visual C++, BASIC, Visual Basic, etc.); Office Suites (word processor, spreadsheet, database, etc.); e-mail; security (firewall, antivirus; spam, spyware, etc.) debugging aids; and diagnostics.
 2. SCADA Software: Software packages independent of specific process control project on which they are used. Includes, but is not limited to, providing configuring and run-time capability for, data acquisition (I/O driver, OPC servers, etc.), monitoring, alarming, human-machine interface, supervisory control, data collection, data retrieval, trending, report generation, control, and diagnostics.
 3. Controller Programming Software: Software packages for the configuring of PLCs, RTUs, DCUs, SLDC, and fieldbus devices.

1.04 SYSTEM DESCRIPTION

- A. Facility upgrades to the Ozone system and related instrumentation, process instrumentation and control system, and control network are included on the Drawings. Control panel modifications shall be provided according to this section.
- B. Design Requirements:
1. The PIC Integrator shall provide the following:
 - a. Complete detailed design of PIC components and PIC drawings including panel wiring diagrams, loop wiring diagrams, and interconnecting wiring diagrams for the following:
 - 1) Headworks Control Panel CP-11000.
 - 2) Sample Station back panels.
 - 3) Network diagram of 31-MCC-01, 32-MCC-01, and 32-MCC-01 connections to the plant control network.
 - 4) When PIC Integrator supplied components terminate to an OSS control panel, the PIC Integrator shall provide make/model, power, termination, and basic connection details to the OSS so the Ozone System drawings can correctly document the new field devices. The OSS will be responsible to document the as-built parameterized spans and settings of any PIC Integrator supplied instruments. The OSS will be responsible to document the as-built network

- documentation of motor starters in MCCs related to the Ozone system. Final As-Built drawings for the Ozone System are the responsibility of the OSS.
- b. Provide consistent hardware and software functions for PIC. For example, provide functions in control logic, sequence controls, and display layouts in same or similar manner.
 - c. PIC design as shown and specified includes:
 - 1) Functional requirements, performance requirements, and component specifications.
 - 2) P&IDs, block diagrams, and network diagrams.
 - d. Drawings for installation details, control panel layouts, control panel schedules, PLC I/O module wiring, panel power, and control diagrams.
- C. The PIC Integrator shall provide the following software modifications to the existing Headworks PLC-11000 (S7-400H series PLC) program. (Note that the existing and the new Headworks PLCs both use the same PLC-11000 designation since the existing PLC will eventually be removed under a future project):
- 1. Modify the Owner's existing PLC and HMI software as required to meet the operational objectives outlined in this specification.
 - 2. Remove control logic associated with Sample Station monitoring and operation from the PLC and HMI/SCADA software at the existing Headworks PLC.
 - 3. If necessary, provide PLC logic to facilitate PLC peer-to-peer communications over plant's ethernet network between the existing Headworks S7-400H Series PLC and the new Headworks S7-1500H Series PLC to facilitate continuity of current operating parameters of the Sample Stations.
- D. The PIC Integrator shall provide the following software functionality in the new Headworks PLC-11000 (S7-1500H series PLC) program, the new OIU, and make associated modifications to existing SCADA software as follows. (Note that the existing and the new Headworks PLCs both use the same PLC-11000 designation since the existing PLC will eventually be removed under a future project):
- 1. Program new PLC and modify existing SCADA software as required to meet the operational objectives outlined in this specification. PLC and SCADA software for analog signals and alarms shall be aligned with the format and configuration of similar signals and alarms in plant's existing software. Configure analog signals for logging to the plant's historical database for trending.

2. Program the new Headworks PLC and Modify SCADA software to replicate all existing Sample Station monitoring and control functions plus the following additional functions:
 - a. FIT-36131A: Provide new analog input signal at PLC-11000 to monitor the new Sample Station 1, R1 Flow Meter. Add associated logic to incorporate analog flow monitoring logic and LOW and LOLO FLOW alarms.
 - b. FIT-36531A: Provide new analog input signal at PLC-11000 to monitor the new Sample Station 1, R5 Flow Meter. Add associated logic to incorporate analog flow monitoring logic and LOW and LOLO FLOW alarms.
 - c. FIT-36132A: Provide new analog input signal at PLC-11000 to monitor the new Sample Station 2, R1 Flow Meter. Add associated logic to incorporate analog flow monitoring logic and LOW and LOLO FLOW alarms.
 - d. FIT-36532A: Provide new analog input signal at PLC-11000 to monitor the new Sample Station 2, R5 Flow Meter. Add associated logic to incorporate analog flow monitoring logic and LOW and LOLO FLOW alarms.
 - e. FIT-36133A: Provide new analog input signal at PLC-11000 to monitor the new Sample Station 3, R1 Flow Meter. Add associated logic to incorporate analog flow monitoring logic and LOW and LOLO FLOW alarms.
 - f. FIT-36533A: Provide new analog input signal at PLC-11000 to monitor the new Sample Station 3, R5 Flow Meter. Add associated logic to incorporate analog flow monitoring logic and LOW and LOLO FLOW alarms.
 - g. FIT-36134A: Provide new analog input signal at PLC-11000 to monitor the new Sample Station 4, R1 Flow Meter. Add associated logic to incorporate analog flow monitoring logic and LOW and LOLO FLOW alarms.
 - h. FIT-36534A: Provide new analog input signal at PLC-11000 to monitor the new Sample Station 4, R5 Flow Meter. Add associated logic to incorporate analog flow monitoring logic and LOW and LOLO FLOW alarms.
 - i. Sample Station Ozone Residual Selector: Provide PLC and HMI/SCADA logic to allow operator to select which sample station ozone residual value is to be used by the ozone generation system for generating ozone. The selection options shall include ozone residuals from Sample Stations 1 through 4. Provide one selector for sample station R1 residual, and one selector for sample station R5 residual. Provide logic to allow the values to be READ by the Ozone System PLC-31000 via PLC peer-to-peer communications.

GRFF OZONE SYSTEM REPLACEMENT

- E. The PIC Integrator shall be responsible for, but not limited to, at least the following work:
1. For PIC Equipment and Ancillaries:
 - a. Completing detail design and fabrication.
 - b. Submittals.
 - c. Equipment, enclosures, and ancillaries.
 - d. Instructions, details, and recommendations to, and coordination with Contractor for Certificate of Proper Installation.
 - e. Verify readiness for operation.
 - f. Verify correctness of final power and signal connections (lugging and connecting).
 - g. Adjusting and calibrating.
 - h. Starting up.
 - i. Testing and coordination of testing.
 - j. Training.
 2. NonPIC Equipment Directly Connected to PIC Equipment:
 - a. Obtain from Contractor, manufacturers' information on installation, interface, function, and adjustment.
 - b. Coordinate with Contractor to allow required interface and operation with PIC.
 - c. For operation and control, verify installations, interfacing signal terminations, and adjustments have been completed in accordance with manufacturer's recommendations.
 - d. Test to demonstrate required interface and operation with PIC.
 - e. Examples of items in this category, but not limited to the following:
 - 1) Valve operators, position switches, and controls.
 - 2) Chemical feed pump and feeder speed/stroke controls.
 - 3) Automatic samplers.
 - 4) Motor control centers.
 - 5) Adjustable speed and adjustable frequency drive systems.
 - f. Examples of items not in this category:
 - 1) Internal portions of equipment provided under Division 26, Electrical, that are not directly connected to PIC equipment.
 - 2) Internal portions of package system instrumentation and controls that are not directly connected to PIC equipment.

1.05 SUBMITTALS

A. General:

1. Submit proposed Submittal breakdown consisting of sequencing and packaging of information in accordance with Project Schedule.

2. Partial Submittals not in accordance with Project Schedule will not be accepted.
3. Submittal Format:
 - a. Hard Copy: Required for all submittals.
 - b. Electronic Copies: Required, unless otherwise noted for specific items.
 - 1) Manufacturers' Standard Documents: Adobe Acrobat PDF.
 - 2) Documents created specifically for Project:
 - a) Text and Graphics: Microsoft Word.
 - b) Lists: Microsoft Excel, unless otherwise noted for specific items.
 - c) Drawings: AutoCAD 2022.
4. Identify proposed items, options, installed spares, and other provisions for future work (for example, reserved panel space; unused components, wiring, and terminals).
5. Legends and Abbreviation Lists:
 - a. Definition of symbols and abbreviations used; for example, engineering units, flowstreams, instruments, structures, and other process items used in nameplates, legends, data sheets, point descriptions, OIU displays, alarm/status logs, and reports.
 - b. Use identical abbreviations in PIC subsections.
 - c. Submit updated versions as they occur.
6. Activity Completion:
 - a. Action Submittals: Completed when reviewed and approved.
 - b. Informational Submittals: Completed when reviewed and found to meet conditions of the Contract.

B. Action Submittals:

1. Bill of Materials: List of required equipment.
 - a. Group equipment items by enclosure and field, and within an enclosure, as follows:
 - 1) PIC Components: By component identification code.
 - 2) Other Equipment: By equipment type.
 - b. Data Included:
 - 1) Equipment tag number.
 - 2) Description.
 - 3) Manufacturer, complete model number and all options not defined by model number.
 - 4) Quantity supplied.
 - 5) Component identification code where applicable.
 - 6) For panels, include panel reference number and name plate inscription.
 - c. Formats: Hard copy and Microsoft Excel.

GRFF OZONE SYSTEM REPLACEMENT

2. Catalog Cuts:
 - a. I&C components, electrical devices, and mechanical devices:
 - 1) Catalog information, marked to identify proposed items and options.
 - 2) Descriptive literature.
 - 3) External power and signal connections.
 - 4) Scaled drawings showing exterior dimensions and locations of electrical and mechanical interfaces.

3. Instrument List:

- a. Engineer will provide an initial Instrument List in Microsoft Excel. Data from this may be used as starting point for creating final Instrument List and Component Data Sheets.
 - b. Applicable fields to be completed include, but are not limited to:

Instrument List Characteristics	
Item	Initially Completed By
Tag Number	Engineer
Description	Engineer
Component Code	Engineer
Existing Manufacturer and Model Number (if available)	Engineer
Installation Details (if available)	Engineer
Range/Setpoint Options	Engineer
Remote/Integral	Engineer
Power	Engineer
P&ID	Engineer
PLC	Engineer
Scope (provided by)	Engineer
Status	Engineer
Manufacturer and complete model number	Contractor

- c. Submit updated version of Instrument List.
 - d. Electronic Copies: Microsoft Excel.
4. Component Data Sheets: Data sheets for I&C components.
 - a. Format:
 - 1) Similar to ISA TR20.00.01.
 - 2) Microsoft Excel, one component per data sheet.

- 3) Submit proposed format for Component Data Sheets before completing data sheets for individual components.
- b. Content:
 - 1) Specific features and configuration data for each component, including but not limited to:
 - a) Tag Number.
 - b) Component type identification code and description.
 - c) Location or service.
 - d) Service conditions.
 - e) Manufacturer and complete model number.
 - f) Size and scale range.
 - g) Setpoints.
 - h) Materials of construction.
 - i) Options included.
 - j) Power requirements.
 - k) Signal interfaces.
 - l) Name, address, and telephone number of manufacturer's local office, representative, distributor, or service facility.
 - c. Electronic Copies: Microsoft Excel.
 - d. Where Contractor proposes "Engineer approved equal" instrument, all supporting documentation must be provided and annotated by the contractor in the instrument submittal to allow the Engineer to review the proposed instrument for approval.
5. Sizing and Selection Calculations:
 - a. Primary Elements:
 - 1) Complete calculations plus process data used.
 - a) Example for Flow Elements: Minimum and maximum values, permanent head loss, and assumptions made.
 - b. Controller, Computing, and Function Generating Modules: Actual scaling factors with units and how they were computed.
 - c. Electronic Copies: Microsoft Excel, one file for each group of components with identical sizing calculations.
6. Preliminary Panel Elevation Drawings:
 - a. Provide prior to submitting Panel Construction Drawings:
 - 1) Scale Drawings: Show dimensions and location of front of panel devices.
 - 2) Panel Legend (Bill of Material): List front of panel devices by tag number. Include nameplate inscriptions, service legends, and annunciator inscriptions.
 - 3) Submit electronic copies of the Drawings.

7. Panel Construction Drawings:
 - a. Scale Drawings: Show dimensions and locations of panel-mounted devices, doors, louvers, subpanels, internal and external.
 - b. Panel Legend (Bill of Material): List front of panel devices by tag numbers, nameplate inscriptions, service legends, and annunciator inscriptions.
 - c. Bill of Materials: List devices mounted within panel that are not listed in panel legend. Include tag number, description, manufacturer, and model number.
 - d. Construction Details: NEMA rating, materials, material thickness, structural stiffeners and brackets, lifting lugs, mounting brackets and tabs, door hinges and latches, and welding and other connection callouts and details.
 - e. Construction Notes: Finishes, wire color schemes, wire ratings, wire, terminal block numbering, and labeling scheme.
 - f. Submit electronic copies of the Drawings.
8. Panel Wiring Diagrams:
 - a. Cover wiring within a panel including, but not limited to, instrumentation, control, power, and communications, and digital networks.
 - b. Objectives: For use in wiring panels, making panel connections, and future panel trouble shooting.
 - c. Diagram Type:
 - 1) Ladder diagrams where applicable to describe wiring and control logic. Include devices that are mounted in or on the panel that require electrical connections. Show unique rung numbers on left side of each rung.
 - 2) Schematic drawings for wiring of circuits that cannot be well represented by ladder diagrams.
 - d. Item Identification: Identify each item with attributes listed.
 - 1) Wires: Wire number and color. Cable number if part of multiconductor cable.
 - 2) Terminals: Location (enclosure number, terminal junction box number, or MCC number), terminal strip number, and terminal block number.
 - 3) Components:
 - a) Tag number, terminal numbers, and location ("FIELD", enclosure number, or MCC number).
 - b) Switching action (open or close on rising or falling process variable), setpoint value and units, and process variable description (for example, Sump Level High).
 - 4) I/O Points: PLC unit number, I/O tag number, I/O address, terminal numbers, and terminal strip numbers.

- 5) Relay Coils:
 - a) Tag number and its function.
 - b) On right side of run where coil is located, list contact location by ladder number and sheet number.
Underline normally closed contacts.
- 6) Relay Contacts: Coil tag number, function, and coil location (ladder rung number and sheet number).
- 7) Communications and Networks: Network type, address or node identification, port or channel number, and type of connector.
- e. Show each circuit individually. No “typical” diagrams or “typical” wire lists will be allowed.
- f. Ground wires, surge protectors, and connections.
- g. Wire and Cable Names: Show names and wire color for circuits entering and leaving a panel. Refer to Division 26, Electrical.
9. Loop Wiring Diagrams: Individual, end-to-end wiring diagram for each analog and discrete or equipment loop.
 - a. Conform to the minimum requirements of ISA S5.4.
 - b. Under Paragraph 5.3 of ISA S5.4, include the information listed under Subparagraphs 2 and 6.
 - c. Show loop components within a panel and identify each component, component terminals, and panel terminals.
 - d. If a loop connects to panels or devices not provided under this section and its subsections, such as control valves, motor control centers, package system panels, variable speed drives, include the following information:
 - 1) Show the first component connected to within the panel or device that is not provided under this section and its subsections.
 - 2) Identify the component by tag and description.
 - 3) Identify panel and component terminal numbers.
 - e. Drawing Size: Individual 11-inch by 17-inch sheet for each loop.
 - f. Divide each loop diagram into areas for panel face, back-of-panel, field, and PLC.
 - g. One Drawing Per Loop: Show each loop individually. No “typical” loop diagrams will be allowed.
 - h. Show:
 - 1) Terminal numbers, location of dc power supply, and location of common dropping resistors.
 - 2) Switching contacts in analog loops and output contacts of analog devices. Reference specific control diagrams where functions of these contacts are shown.
 - 3) Tabular summary on each analog loop diagram:
 - a) Transmitting Instruments: Output capability.
 - b) Receiving Instruments: Input impedance.

GRFF OZONE SYSTEM REPLACEMENT

- c) Loop Wiring Impedance: Estimate based on wire sizes and lengths shown.
 - d) Total loop impedance.
 - e) Reserve output capacity.
 - 4) Circuit and raceway schedule names.
- 10. Communications and Digital Networks Diagrams:
 - a. Scope: Includes connections to Profinet Ethernet network, remote I/O, and Profibus.
 - b. Format: Network schematic diagrams for each different type of network.
 - c. Show:
 - 1) Interconnected devices, both passive and active.
 - 2) Device names and numbers.
 - 3) Terminal numbers.
 - 4) Communication Media: Type of cable.
 - 5) Connection Type: Type of connector.
 - 6) Node and device address numbers.
 - 7) Wire and cable numbers and colors.
- 11. Panel Power Requirements and Heat Dissipation:
 - a. For control panels tabulate and summarize:
 - 1) Required voltages, currents, and phases(s).
 - 2) Maximum heat dissipations BTU per hour.
 - 3) Calculations.
 - 4) Steady State Temperature Calculations: For nonventilated panels, provide heat load calculations showing the panel estimated internal steady state temperature for ambient air temperatures of 100 degrees F.
- 12. Panel Plumbing Diagrams:
 - a. For each panel containing piping and tubing. Show type and size for:
 - 1) Pipes and Tubes: Thickness, pressure rating, and materials.
 - 2) Components: Valves, regulators, and filters.
 - 3) Connections to panel-mounted devices.
 - 4) Panel interface connections.
 - 5) Submit electronic copies of the Drawings.
- 13. Installation Details: Include modifications or further details required and define installation of I&C components.
- 14. Spares, expendables, and test equipment.
- 15. Electronic Copies: Microsoft Excel.
- 16. PLC I/O List:
 - a. Managed by PIC Integrator:
 - 1) During construction PIC Integrator will maintain PLC I/O List and give electronic Microsoft Excel copies to Engineer.
 - 2) PIC Integrator will assign PLC I/O points to specific chassis, slot, and point addresses.

- b. PLC I/O List Changes: Changes to PLC I/O List reflecting actual equipment and instrumentation provided by the PIC System Integrator at 30-day intervals.
 - 1) Mark up electronic file of latest PLC I/O List. Highlight changed cells with yellow, new rows with red, and rows to be deleted with green.
- 17. Shop Drawings for Changes Impacting PLC and SLDC Programming:
 - a. Submit details of changes required to PLC and SLDC monitoring and control resulting from installation of alternative or upgraded process equipment and instrumentation, and other causes.
 - b. Submit changes at 30-day intervals.
- 18. Color schedule for control panels.
- 19. Applications Software Documentation:
 - a. For equipment for which Engineer does not provide applications software provide:
 - 1) Complete configuration documentation for microprocessor based programmable devices.
 - 2) For each device, include program listings and function block diagrams, as appropriate, showing:
 - a) Functional blocks or modules used.
 - b) Configuration, calibration, and tuning parameters.
 - c) Descriptive annotations.
 - 3) Refer to PIC subsections for additional requirements.
- 20. Cybersecurity Approach: Provide a copy of security best practices which will be implemented by PIC Integrator.

C. Informational Submittals:

- 1. Statements of Qualification:
 - a. PIC Integrator's site representative.
 - b. Resume for each PIC Integrator's onsite startup and testing team member (engineers, technicians, and software/configuring personnel).
 - c. PIC Installer.
- 2. Operation and Maintenance Data:
 - a. In accordance with Section 01 78 23, Operation and Maintenance Data, and in addition the following:
 - 1) General:
 - a) Provide sufficient detail to allow operation, removal, installation, adjustment, calibration, maintenance and purchasing replacements for PIC components.
 - b) Submittal Format: Both hard copy and electronic copies for all submittals. Refer to Article Submittals, heading Submittal Format.
 - 2) Final versions of Legend and Abbreviation Lists.

GRFF OZONE SYSTEM REPLACEMENT

- 3) Process and Instrumentation Diagrams: Marked up copy of revised P&ID to reflect as-built PIC design.
 - 4) Provide the following items as defined under heading Action Submittals:
 - a) Bill of materials.
 - b) Catalog cuts.
 - c) Instrument list.
 - d) Component data sheets.
 - e) Detailed Wiring Diagrams: As-Built Drawings.
 - (1) Panel wiring diagrams.
 - (2) Loop diagrams.
 - (3) Interconnecting wiring diagrams.
 - f) Panel plumbing diagrams.
 - g) Applications software documentation.
 - 5) Manufacturer's O&M manuals for components, electrical devices, and mechanical devices:
 - a) Content for Each O&M Manual:
 - (1) Table of Contents.
 - (2) Operations procedures.
 - (3) Installation requirements and procedures.
 - (4) Maintenance requirements and procedures.
 - (5) Troubleshooting procedures.
 - (6) Calibration procedures.
 - (7) Internal schematic and wiring diagrams.
 - (8) Component and I/O Module Calibration Sheets from field quality control calibrations.
 - b) Provide PDF file with linked index to all manuals.
 - 6) List of spares, expendables, test equipment and tools provided.
 - 7) List of additional recommended spares, expendables, test equipment, and tools. Include quantities, unit prices, and total costs.
3. Provide Manufacturer's Certificate of Proper Installation where specified.
 4. Testing Related Submittals:
 - a. Factory Acceptance Test (FAT):
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures:
 - a) Proposed test procedures, forms, and checklists.
 - b) Capacity, Timing, and Simulation: Describe simulation and monitoring methods used to demonstrate compliance with capacity and timing requirements.

- c) Provide space after each test item description for sign off by appropriate party after satisfactory completion.
 - 3) Test Documentation: Copy of signed off test results.
- b. Operational Readiness Test (ORT):
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures: Proposed test procedures, forms, and checklists.
 - 3) Test Documentation:
 - a) Copy of signed-off test results.
 - b) Completed component calibration sheets.
- c. Functional Demonstration Test (FDT):
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures: Proposed test procedures, forms, and checklists.
- 5. Test Documentation: Copy of signed-off test results.
- 6. Owner Training Plan: In accordance with Section 01 43 33, Manufacturers' Field Services.
- 7. Maintenance Service Agreement: Prior to Substantial Completion, submit service agreements signed by Owner and maintenance provider for work required under Section 01 77 00, Closeout Procedures.

1.06 QUALITY ASSURANCE

A. Qualifications:

- 1. PIC Integrator: Minimum of 10 years' experience providing, integrating, installing, and starting up similar systems as required for this Project.
 - a. PIC Integrator shall be:
 - S&B, Inc.
 - 13200 S.E. 30th Street, Suite A
 - Bellevue, WA 98005
 - Phone: (425) 644-1700
 - Email: jstead@sb-inc.com
- 2. PIC Installer: Minimum of 5 years' experience installing systems similar to PIC required for this Project.

B. PIC Coordination Meetings:

- 1. General: Refer to Section 01 31 19, Project Meetings, for PIC coordination meetings.

GRFF OZONE SYSTEM REPLACEMENT

2. PIC Schedule Coordination Meeting:
 - a. Timing: Following Engineer review of PIC Schedule.
 - b. Purpose: Discuss Engineer's comments and resolve scheduling issues.
3. Training Coordination Meeting:
 - a. Timing: Following Engineer review of preliminary training plan.
 - b. Purpose:
 - 1) Resolve required changes to proposed training plan.
 - 2) Identify specific Owner personnel to attend training.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Section 01 61 00, Common Product Requirements.
- B. Prior to shipment, include corrosive inhibitive vapor capsules in shipping containers, and related equipment as recommended by capsule manufacturer.
- C. Prior to installation, store items in dry indoor locations. Provide heating in storage areas for items subject to corrosion under damp conditions.
- D. Cover panels and other elements that are exposed to dusty construction environments.

1.08 SEQUENCING AND SCHEDULING

- A. Refer to Section 01 31 13, Project Coordination, for Contractor's scheduling requirements for applications software testing.
- B. Prerequisite Activities and Lead Times: Do not start following key Project activities until prerequisite activities and lead times listed below have been completed and satisfied:
 1. Shop Drawing Reviews by Engineer:
 - a. Prerequisite: Engineer acceptance of Schedule of Values and Progress Schedule.
 - b. Schedule: In accordance with completed schedule of Shop Drawing and Sample submittals specified in Section 01 33 00, Submittal Procedures.
 2. Test Prerequisite: Associated test procedures Submittals completed.
 3. Training Prerequisite: Associated training plan Submittal completed.
 4. PLC and OIU Shipment to Site:
 - a. General Prerequisites:
 - 1) Approval of PIC Shop Drawings and preliminary operation and maintenance data.
 - 2) FAT completed.
 5. PLC and OIU Installation Prerequisite: Equipment received at Site.

6. Operational Readiness Test Prerequisite: PLC and OIU installation complete.
7. Functional Demonstration Test Prerequisite: Operational Readiness Test completed and facility started up.

1.09 EXTRA MATERIALS

- A. As specified in PIC subsections.
- B. Provide one spare Siemens S7 1500H Series high availability PLC and one spare of each I/O and communication module type used in the detailed PIC design.
- C. In computing spare parts quantities based on specified percentages, round up to nearest whole number.
- D. Spare Parts:

Description	Percent of Each Type and Size Used	No Less Than
Annunciator light bulbs	20	10
Annunciator window module	10	5
dc power supplies	20	2
Fuses	20	5
Indicating light bulb	20	10
Relays	20	3
Terminal Blocks	10	10
Hand Switches and Lights	10	5
120V ac Isolation Transformers	10	2
Surge Suppressors	10	2

1. If no parts of a listed spares category are used in a PIC Integrator deliverable, then a zero quantity is acceptable.

E. Expendables:

1. For the following items, provide manufacturer's recommended 2-year supply, from time of equipment delivery, unless otherwise noted.
 - a. Chemical for analyzers.
 - b. Calibration/test gas for combustible gas detection.

GRFF OZONE SYSTEM REPLACEMENT

- c. Corrosion-inhibiting vapor capsules.
- d. Spray pump filter adhesive: Hoffman; Model A-FLTAD. One pint per panel with air filters.

PART 2 PRODUCTS

2.01 GENERAL

- A. All programmable logic controller (PLC), remote I/O, and network hardware to be salvaged and returned to the Owner. Reference Section 02 41 00, Demolition, for control panel salvage requirements.
- B. Do not lock software programs, subroutines, or function blocks.
- C. The PIC Integrator is responsible for the detailed design, factory fabrication, testing, and commissioning of all control panels and back panels as required in Specifications and shown on the Drawings.
- D. The PIC Installer is responsible for the installation scope of the PIC Integrator's supplied equipment. All communication cabling shall be supplied by the Contractor. Provide wiring, conduit, and communications equipment necessary to facilitate communication on the new redundant Profinet communications networks.
- E. Provide new multi-section Headworks Control Panel:
 - 1. Provide redundant PLCs, I/O racks, I/O modules, communications modules, network switches, field terminals, and all other components necessary to monitor and control existing hardwired I/O that will be migrated from the existing Headworks Console Cabinets under a future project. The intent is for the new panel to be physically equipped such that only PLC I/O checks and new PLC code associated with those I/O points will need to be provided under the future project when the I/O is actually migrated. The existing Headworks S7-400H series redundant PLC in console section A will remain in place and continue to control the existing Profibus I/O in the console sections until the future migration. However, all PLC logic and control functions associated with the Sample Stations shall be migrated to the new redundant S7-1500H series PLCs in the new Headworks Control Panel.
 - 2. Provide fully equipped to communicate on the plant's redundant Profinet control networks as specified herein and shown on the Drawings.

- F. For each of the Sample Station Control Panels CP-36001 through CP-36005, provide new back panel and OIU and replace existing in accordance with the requirements of this Section. For each control panel:
1. New back panel, PLC control, and OIU functions shall replicate all existing functions plus any new functions or components specified herein or shown on the Drawings.
 2. Back panel layout design must position equipment and terminals on new panel such that existing field wires can reach termination points on the new panel.
 3. De-terminate wires from and remove existing back panel and OIU.
 - a. Salvage these to Owner.
 - b. Remove existing Cisco VLAN network switch as shown on drawings prior to back panel removal and retain for reinstallation on the new back panel after it is installed.
 - c. The existing enclosures, panel doors, and panel door components (except for OIUs) will be retained.
 4. Install new back panel, re-terminate field I/O, and rewire panel door components.
 - a. Install existing Cisco VLAN network switch on new back panel.
 5. Provide, program, and install new OIU.
 - a. Modify enclosure door as necessary for installation of new OIU to maintain the existing control panel NEMA rating.
 6. Provide and install new UPS in the enclosure.
 - a. Connect the UPS Ethernet connection to existing Cisco VLAN network switch to enable UPS monitoring.
- G. The PIC Integrator shall provide, configure, test, and deliver network equipment in the following panels and MCCs as shown on the Block Diagram Drawings and required herein to convert the existing redundant Profibus network to a redundant Profinet network. Provide fiber and Ethernet patch cables and components as necessary to connect to the new equipment and facilitate a fully functional Profinet network with Siemens R1 redundancy similar to the existing Profibus network:
1. CP-11000 Headworks Panel.
 2. CP-36001 Sample Station 1 Panel.
 3. CP-36002 Sample Station 2 Panel.
 4. CP-36003 Sample Station 3 Panel.
 5. CP-36004 Sample Station 4 Panel.
 6. CP-36005 Sample Station 5 Panel.
 7. COMM-31000 Area 31 Communications Panel.
 8. COMM-32000 Area 32 Communications Panel.
 9. COMM-33000 Area 33 Communications Panel.
 10. 31-MCC-01 Area 31 MCC.

GRFF OZONE SYSTEM REPLACEMENT

11. 32-MCC-01 Area 32 MCC.
 12. 33-MCC-01 Area 33 MCC.
- H. Provide and install communications cable to connect the new Ozone Facility UPS to the OZONE-BLDG-AS01 VLAN network switch located in COMM-31000 Area 31 Communications Panel.
- I. Install OSS provided instruments in accordance with the requirements of Veolia Power Supply Unit Procurement Proposal and Control Panel Procurement Proposal, Section 44 44 56.10, Ozone System Instruments, included in Part 3 of this package.
- J. Provide onsite field support for OSS during testing and commissioning of the Ozone System Upgrades. Support shall be sufficient to address problems that may arise with equipment or installations provided under this project, including OSS provided equipment.
- K. Provide PIC functions shown on the Drawings and required in PIC subsections for each system and loop. Furnish equipment items required in PIC subsections. Furnish materials, equipment, and software, whether indicated or not, necessary to effect required system and loop performance.
- L. First Named Manufacturer: PIC design is based on first named manufacturers of equipment, materials, and software.
1. If an item is proposed from other than first named manufacturer, obtain approval from Engineer for such changes in accordance with the General Conditions, Article 6.05 Substitutes and "Or-Equals".
 2. If proposed item requires, but not limited to, different installation, wiring, raceway, enclosures, intrinsically safe barriers, and accessories, provide such equipment and work.
- M. Like Equipment Items:
1. Use products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.
 2. Implement same or similar functions in same or similar manner. For example control logic, sequence controls, and display layouts.
- N. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the

maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 I&C COMPONENTS

- A. Provide Instrumentation as specified in Section 40 91 00, Instrumentation and Control Components.
 1. Unless otherwise specified, instruments provided by Contractor shall be configured and commissioned by:
 - a. The instrument manufacturer's representative
 - b. Qualified system integrator with at least five years experience configuring the same type of instrument. This includes all configuration necessary to facilitate the functional requirements of the project.
- B. Components for Each Loop: Major components for each loop are listed in Supplement Instrument List referenced in Article Supplements. Furnish equipment that is necessary to achieve required loop performance.
- C. Enclosures:
 1. Provide new NEMA 12 freestanding enclosure for Headworks Control Panel.
 2. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), UL 508, state and local codes, and applicable sections of NEMA, ANSI, and ICECA.
 3. Finish: Blue enamel.
 4. Manufacturer: Saginaw.
- D. Control Enclosure Back and Side Panels:
 1. Design each back and side panel to mount in existing enclosure and maintain connections to existing wiring including wiring to field I/O and to items installed on panel door including the OIU, and selector switches.
 - a. Back and side panel size, gauge, and mounting holes locations shall match existing.
 - b. Position new component and field I/O terminals in same location as existing so that existing wires reach new terminal locations.

GRFF OZONE SYSTEM REPLACEMENT

2. Design new I/O interface to receive existing component and field I/O signals.
 - a. Match signal voltage, type, and function to existing.
 - b. Wire and component labelling shall match existing labelling.
3. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), UL 508A, state and local codes, and applicable sections of NEMA, ANSI, and ICECA.
4. Minimum of one 120-volt GFCI duplex receptacle for panels 12 cubic feet and larger. Limit circuit amperage to 5A.
5. Finish: White enamel.
6. Back and Side Panel Manufacturers: Saginaw for new enclosures, same as enclosure manufacturer for existing enclosures.

2.03 PROGRAMMABLE LOGIC CONTROLLERS

- A. Provide redundant PLC and Remote I/O on back panel in new Headworks Control Panel CP-11000.
 1. Provide associated Remote I/O in Sample Station Control Panels CP-36001/2/3/4/5.
 2. Provide all components and features necessary to maintain bumpless Siemens R1 redundancy throughout the control system similar to existing system, for example if PN/PN couplers needed to allow a PLC with S1 redundancy to function bumplessly on an R1 system, etc.
- B. Provide I/O interface that aligns with, and will connect with, existing I/O signals without need to modify those signals. Any new discrete inputs shall be 24V dc, and new discrete outputs shall be 24V dc. Each input and output shall have an LED ON/OFF status indicator. Discrete outputs shall include separate interposing relay to allow interface with external voltages.
- C. Minimum of 25 percent excess capacity for inputs, outputs, internal coils, registers, and other necessary functions.
- D. Capable of operating in a hostile industrial environment (for example, heat, electrical transients, RFI, and vibration) without fans, air conditioning, or electrical filtering. Units operate from 0 degree C to 60 degrees C and up to 95 percent humidity, noncondensing.
- E. Module Firmware Version: Most current available at time of submittal for each module type used.
- F. Communications: each PLC shall be equipped with PROFINET communications capability.

G. Manufacturer and Products:

1. Siemens; Simatic PCS7 CPU 1500H Series high availability redundant controller, no substitutions.
2. Remote I/O: ET200SP HA Series distributed I/O and communication card components, no substitutions.

2.04 OIU COMPONENTS

- A. Provide panel mounted OIU for installation on existing panel door, each panel.
- B. Display: 12-inch widescreen TFT touchscreen, 16M colors.
- C. Supply Power: 24V dc.
- D. Communications: PROFINET interface.
- E. Manufacturer and Product: Siemens; Simatic HMI MTP1200, Unified Comfort Panel; no substitutions.

2.05 NETWORK COMPONENTS

A. Switches:

1. Managed layer two switch, IEC62443-4-2 certified.
2. Full Gigabit, 6x 10/100/1,000 Mbps RJ45 ports, 2x 1,000 Mbps combo ports, 1x console port.
3. Provide components for fiber-optic connections at each switch including SFP transceivers.
4. Redundant power supply.
5. PROFINET I/O Device, Ethernet I/P compliant.
6. Manufacturer and Product: Siemens; SCALANCE XC-200 series managed; no substitutions.
7. Provide the following switches:
 - a. COMM-31000:
 - 1) 16 Port; Quantity: One.
 - 2) Six Port; Quantity: Two.
 - b. COMM-32000:
 - 1) Six Port; Quantity: Three.
 - c. COMM-33000:
 - 1) 16 Port; Quantity: One.
 - 2) Six Port; Quantity: Two.
 - d. CP-36001:
 - 1) Six Port; Quantity: Three.

GRFF OZONE SYSTEM REPLACEMENT

- e. CP-36002:
 - 1) Six Port; Quantity: Three.
- f. CP-36003:
 - 1) Six Port; Quantity: Three.
- g. CP-36004:
 - 1) Six Port; Quantity: Three.
- h. CP-36005:
 - 1) Six Port; Quantity: Three.

B. Y-Switches:

- 1. General:
 - a. Type: Managed Industrial Ethernet Y-switch.
 - b. Certification: IEC 62443-4-2.
- 2. Interfaces:
 - a. Ethernet Ports: 4 x 10/100 Mbps.
 - b. BusAdapter Interfaces: 2 x BusAdapter interface.
 - c. Connectors: 2xRJ45.
- 3. Power Supply:
 - a. Redundant Power Supply: 24V dc.
- 4. Environmental Specifications:
 - a. Operating Temperature Range: Minus 40 degrees C to 70 degrees C.
 - b. Conformal Coating: Yes.
 - c. Installation Altitude: Up to 4,000 meters.
- 5. Features:
 - a. Error Signaling Contact: Yes.
 - b. Set Pushbutton: Yes.
 - c. PROFINET Device: Yes.
 - d. Manual: Electronic manual on DVD.
 - e. Optional Accessories: C-PLUG.
- 6. Bus Adapters: Provide BusAdapters as required.
- 7. Manufacturer and Product: Siemens; SCALANCE XF204-2BA DNA.
No substitutions.

2.06 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. General:

- 1. Function: Provides isolated, regulated uninterrupted ac output power during a complete or partial interruption of incoming line power.
- 2. Major Parts: Inverter, battery charger, sealed battery.

- B. Performance:
 - 1. Capacity: 150 percent of connected load.
 - 2. Backup Runtime:
 - a. Full Load: 15 minutes minimum.
 - b. Half Load: 30 minutes minimum.
 - 3. Input Power:
 - a. 120V ac single phase, 60-Hz, unless otherwise noted.
 - b. Connections: Manufacturer's standard, unless otherwise noted.
 - 4. Continuous no-break power with no measurable transfer time.
- C. Output Power:
 - 1. 120V ac single phase, 60-Hz, unless otherwise noted.
 - 2. Connections: Manufacturer's standard, unless otherwise noted.
- D. On-line Efficiency: 85 percent minimum, unless otherwise noted.
- E. Backup Runtime:
 - 1. Full Load: 15 minutes minimum, unless otherwise noted.
 - 2. Half Load: 30 minutes minimum, unless otherwise noted.
- F. Continuous no-break power with no measurable transfer time.
- G. Sine-Wave Output Voltage Total Harmonic Distortion (THD): Plus or minus 6 percent or less.
- H. Input Voltage Range: Plus 15 percent, minus 20 percent.
- I. Output Voltage Regulation: Plus or minus 3 percent nominal.
- J. Operating Temperature: 0 degrees C to 40 degrees C (32 degrees F to 104 degrees F).
- K. Operating Relative Humidity: 5 percent to 95 percent without condensation.
- L. Lightning and Surge Protection:
 - 1. Pass lightning standard IEEE C62.41 Categories A and B tests.
 - 2. 2,000 to 1 attenuation of input spike.
- M. External Signals:
 - 1. UPS Fail Status: Provide with one normally open dry contact rated at 120V ac, 2A minimum.

GRFF OZONE SYSTEM REPLACEMENT

N. Features:

1. Enclosure: Tower, unless otherwise noted.

O. Installation: UL508A rated units shall be installed inside a control panel, located at the bottom of the enclosure.

P. Features:

1. Bypass: Built-in.
2. User replaceable batteries.
3. Discrete Output: One SPDT contact, rated at 5 amps continuous, at 120V ac for Common Alarm.

Q. Manufacturers and Products: Eaton 9PX Series, UL508A rated, no exceptions.

2.07 SERVICE CONDITIONS

A. Standard Service Conditions:

1. The following defines certain types of environments. PIC subsections refer to these definitions by name to specify the service conditions for individual equipment units. Design equipment for continuous operation in these environments:
 - a. Inside, Air Conditioned:
 - 1) Temperature:
 - a) Normal: 60 degrees F to 80 degrees F.
 - b) With Up to 4-Hour HVAC System Interruptions: 40 degrees F to 105 degrees F.
 - 2) Relative Humidity:
 - a) Normal: 10 percent (winter) to 70 percent (summer).
 - b) With Up to 4-Hour HVAC System Interruption: 10 percent to 100 percent.
 - 3) NEC Classification: Nonhazardous.
 - b. Inside:
 - 1) Temperature: 20 degrees F to 120 degrees F.
 - 2) Relative Humidity: 10 percent to 100 percent.
 - 3) NEC Classification: Nonhazardous.

B. Standard Service Conditions for Panels and Consoles:

1. Unless otherwise noted, in Supplement Instrument List, design equipment for continuous operation in these environments:
 - a. Freestanding Panel and Consoles:
 - 1) Inside, Air Conditioned: NEMA 1.
 - 2) Inside: NEMA 12.

- b. Smaller Panels and Assemblies (that are not freestanding):
 - 1) Inside, Air Conditioned: NEMA 12.
 - 2) All Other Locations: NEMA 4X.
 - c. Field Elements: Outside.
- C. Special Environmental Requirements: Design following panels for continuous operation in environments listed.

2.08 INSTRUMENT TAG NUMBERS

- A. A shorthand tag number notation is used. For example:

AAA-FPL LDS

Notation	Explanation
AAA	ISA designator
F	Facility number
P	Process number
L	Loop number
D	Device number
S	Second device number; number of same component types with same first device number in a given loop

2.09 NAMEPLATES, TAGS, AND SERVICE LEGENDS

- A. Panel Nameplates: Enclosure identification located on enclosure face.
 - 1. Materials: Laminated plastic attached to panel with stainless steel screws.
 - 2. Letters: 1/2-inch high, white on black background, unless otherwise noted.
- B. Component Nameplates, Panel Face: Component identification located on panel face under or near component.
 - 1. Location and Inscription: As shown on the Panel Drawing.
 - 2. Materials: Adhesive-backed, laminated plastic.
 - 3. Letters: 3/16-inch high, white on black background, unless otherwise noted.

GRFF OZONE SYSTEM REPLACEMENT

- C. Service Legends: Component identification nameplate located on face of component.
 - 1. Inscription: As shown on the Panel Drawing.
 - 2. Materials: Adhesive-backed, laminated plastic.
 - 3. Letters: 3/16-inch high, white on black background, unless otherwise noted.
- D. Nametags: Component identification for field devices.
 - 1. Inscription: Component tag number.
 - 2. Materials: 16-gauge, Type 304 stainless steel.
 - 3. Letters: 3/16-inch high, imposed.
 - 4. Mounting: Affix to component with 16-gauge or 18-gauge stainless steel wire or stainless steel screws.

2.10 MECHANICAL SYSTEM COMPONENTS

- A. Reference Section 40 91 00, Instrumentation and Control Components.

2.11 ELECTRICAL REQUIREMENTS

- A. Electrical Raceways: As specified in Section 26 05 33, Raceway and Boxes.
- B. Wiring External to PIC Equipment:
 - 1. Special Control and Communications Cable: Provided by PIC System Integrator as noted in Component Specifications and PIC subsections.
 - 2. Other Wiring and Cable: As specified in Section 26 05 05, Conductors.
- C. I&C and electrical components, terminals, wires, and enclosures UL recognized or UL listed.
- D. Control Panels without Motor Starters:
 - 1. Furnish main circuit breaker and a circuit breaker on each individual branch circuit distributed from power panel.
 - 2. Locate to provide clear view of and access to breakers when door is open. Group on single subpanel. Provide typed directory.
 - 3. Circuit Breakers:
 - a. Coordinate such that fault in branch circuit trips branch breaker and not main breaker.
 - b. Branch Circuit Breakers: 15 amps at 250V ac, UL 489 listed.
 - c. Breaker Manufacturers and Products:
 - 1) Eaton; Series AMR.
 - 2) Siemens.

E. Wires within Enclosures:

1. AC Power Circuits:
 - a. Type: 600-volt, Type MTW stranded copper.
 - b. Size: For current to be carried, but not less than 14 AWG.
2. AC Control Circuits:
 - a. Type: 600-volt, Type MTW stranded copper.
 - b. Size: For current to be carried, but not less than 16 AWG.
3. Analog Signal Circuits:
 - a. Type: 300-volt, Type 2 stranded copper, twisted shielded pairs.
 - b. Size: 18 AWG, minimum.
 - c. Manufacturer and Product: Belden; 9341.
4. Other dc Circuits.
 - a. Type: 600-volt, Type MTW stranded copper.
 - b. Size:
 - 1) Digital Input: 18 AWG, minimum.
 - 2) Digital Output: 18 AWG, minimum.
 - 3) Power Supply: 14 AWG, minimum.
5. Separate analog and other dc circuits by at least 6 inches from ac power and control wiring, except at unavoidable crossover points and at device terminations.
6. Enclose wiring in sheet metal raceways or plastic wiring ducts.
7. Wire Identification: Numbered and tagged at each termination.
 - a. Wire Tags: Machine printed, heat shrink.
 - b. Manufacturers:
 - 1) Brady PermaSleeve.
 - 2) Tyco Electronics.
8. Special Signal Circuits: Use manufacturer's standard cables.

F. Terminate and identify wires entering or leaving enclosures as follows:

1. Analog and discrete signal, terminate at numbered terminal blocks.
2. Special signals terminated using manufacturer's standard connectors.
3. Identify wiring in accordance with requirements in Section 26 05 05, Conductors.

G. Terminal Blocks for Enclosures:

1. Quantity:
 - a. Accommodate present and spare indicated needs.
 - b. Wire spare PLC I/O points to terminal blocks.
 - c. One wire per terminal for field wires entering enclosures.
 - d. Maximum of two wires per terminal for 18 AWG wire for internal enclosure wiring.

GRFF OZONE SYSTEM REPLACEMENT

- e. Spare Terminals: 20 percent of connected terminals, but not less than 10 per terminal block, unless otherwise shown on the Drawings.
 - 2. Terminal Block Types: Reference Section 40 91 00, Instrumentation and Control Components, Part 2, Article Electrical Components.
- H. Grounding of Enclosures:
- 1. Furnish isolated copper grounding bus for signal and shield ground connections.
 - 2. Ground this ground bus at a common signal ground point in accordance with National Electrical Code requirements.
 - 3. Single Point Ground for Each Analog Loop:
 - a. Locate signal ground at dc power supply for loop.
 - b. Use to ground wire shields for loop.
 - 4. Ground terminal block rails to ground bus.
- I. Analog Signal Isolators:
- 1. Furnish signal isolation for analog signals that are sent from one enclosure to another.
 - 2. Do not wire in series instruments on different panels, cabinets, or enclosures.
- J. Intrinsic Safety System Installation:
- 1. Comply with NEC Article 504, Intrinsically Safe Systems.
 - 2. Install intrinsically safe circuits in a separate wire way that:
 - a. Is separated from nonintrinsically safe circuits as specified by NEC.
 - b. Is colored light blue and has message "Intrinsically Safe Circuits Only" on raceway cover every 6 inches.
- K. Wiring Interface: Terminate and identify wiring entering or leaving enclosures.
- 1. Analog and Discrete Signal Wires: Terminate at numbered terminal blocks as shown on the wiring diagrams.
 - 2. Wiring for Special Signals: Terminate communications, digital data, and multiplexed signals using manufacturer's standard connectors for the device to which the signals terminate.

L. Electrical Transient Protection:

1. General:
 - a. Function: Protect elements of PIC against damage due to electrical transients induced in interconnecting lines by lightning and nearby electrical systems.
 - b. Surge suppressors are not shown for external analog transmitters. Determine quantity and location, and show in the Shop Drawings. Refer to example wiring in installation details on the Drawings.
 - c. Provide, install, coordinate, and inspect grounding of surge suppressors at:
 - 1) Connection of ac power to PIC equipment including panels, consoles assemblies, and field-mounted analog transmitters and receivers.
 - 2) At the field and panel, console, or assembly connection of signal circuits that have portions of the circuit extending outside of a protective building.
2. Surge Suppressor Types: Reference Section 40 91 00, Instrumentation and Control Components, Part 2, Surge Suppressors.
3. Installation and Grounding of Suppressors:
 - a. As shown. See Surge Suppressor Installation Details.
 - b. Grounding equipment, installation of grounding equipment, and terminations for field mounted devices are provided under Division 26, Electrical.

2.12 PANEL FABRICATION

A. General:

1. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), state and local codes, and applicable sections of NEMA, ANSI, UL, and ICECA.
2. Fabricate panels, install instruments and wire, and plumb at PIC System Integrator's facility. No fabrication other than correction of minor defects or minor transit damage permitted onsite.
3. UL Listing Mark for Enclosures: Mark stating "Listed Enclosed Industrial Control Panel" per UL 508A.
4. Electrical Work: In accordance with the applicable requirements of Division 26, Electrical.

GRFF OZONE SYSTEM REPLACEMENT

B. Temperature Control:

1. Freestanding Panels:
 - a. Nonventilated Panels: Size to adequately dissipate heat from equipment mounted inside panel and on panel.
 - b. Ventilated Panels:
 - 1) Furnish with louvers and forced ventilation as required to prevent temperature buildup from equipment mounted inside panel and on panel.
 - 2) For panels with backs against wall, furnish louvers on top and bottom of panel sides.
 - 3) For panels without backs against wall, furnish louvers on top and bottom of panel back.
 - 4) Louver Construction: Stamped sheet metal.
 - 5) Ventilation Fans:
 - a) Furnish where required to provide adequate cooling.
 - b) Create positive internal pressure within panel.
 - c) Fan Motor Power: 120V ac, 60-Hz, thermostatically controlled.
 - 6) Air Filters: Washable aluminum, Hoffman Series A-FLT.
 - c. Refrigerated System: Furnish where heat dissipation cannot be adequately accomplished with natural convection or forced ventilation.
2. Smaller Panels (that are not freestanding): Size to adequately dissipate heat from equipment mounted inside panel and on panel face.
3. Space Heaters:
 - a. Thermostatically controlled to maintain internal panel temperatures above dewpoint.
 - b. Refer to Control Panel Schedule in Article Supplements.

C. Freestanding Panel Construction:

1. Materials:
 - a. Sheet steel.
 - b. Minimum Thickness: 10-gauge, unless otherwise noted.
2. Panel Front:
 - a. Fabricated from a single piece of sheet steel, unless otherwise shown on the Drawings.
 - b. No seams or bolt heads visible when viewed from front.
 - c. Panel Cutouts: Smoothly finished with rounded edges.
 - d. Stiffeners: Steel angle or plate stiffeners or both on back of panel face to prevent panel deflection under instrument loading or operation.

3. Internal Framework:
 - a. Structural steel for instrument support and panel bracing.
 - b. Permit panel lifting without racking or distortion.
 4. Lifting rings to allow simple, safe rigging and lifting of panel during installation.
 5. Adjacent Panels: Securely bolted together so front faces are parallel.
 6. Door:
 - a. Full height, fully gasketed access door where shown on the Drawings.
 - b. Latch: Three-point, Southco; Type 44.
 - c. Handle: "D" ring, foldable type.
 - d. Hinges: Full-length, continuous, piano-type, steel hinges with stainless steel pins.
 - e. Rear Access: Extend no further than 24 inches beyond panel when opened to 90-degree position.
 - f. Front and Side Access Doors: As shown on the Drawings.
- D. Breather and Drains: Furnish with NEMA 250, Type 4 and 4X panels.
1. Manufacturer and Product: Cooper Crouse-Hinds; ECD Type 4X Drain and Breather; Drain Model ECD1-N4D, Breather Model ECD1-N4B.
- E. Control Panel Electrical:
1. Power Distribution within Panels:
 - a. Feeder Circuits:
 - 1) One or more 120V ac, 60-Hz feeder circuits as shown on the Drawings.
 - 2) Make provisions for feeder circuit conduit entry.
 - 3) Furnish terminal block for termination of wires.
 - b. Power Panel: Furnish main circuit breaker and circuit breaker on each individual branch circuit distributed from power panel.
 - 1) Locate to provide clear view of and access to breakers when door is open.
 - 2) Breaker Sizes: Coordinate such that fault in branch circuit will blow only branch breaker, but not trip main breaker.
 - a) Branch Circuit Breakers: 15 amps at 250V ac.
 - 3) Breaker Manufacturers and Products: Refer to Division 26, Electrical.
 - c. Circuit Wiring:
 - 1) Devices on Single Circuit: 20, maximum.
 - 2) Multiple Units Performing Parallel Operations: To prevent failure of any single branch circuit from shutting down entire operation, do not group all units on same branch circuit.

GRFF OZONE SYSTEM REPLACEMENT

- 3) Branch Circuit Loading: 12 amperes continuous, maximum.
 - 4) Panel Lighting and Service Outlets: Put on separate 15 amp, 120V ac branch circuit.
 - 5) Provide 120V ac plugmold for panel components with line cords.
2. Signal Distribution:
 - a. Signal Wiring: Separate analog signal cables from power and control within a panel and cross at right angles where necessary.
 - b. Within Panels: 4 mA dc to 20 mA dc signals may be distributed as 1V dc to 5V dc.
 - c. Outside Panels: Isolated 4 mA dc to 20 mA dc only.
 - d. Signal Wiring: Twisted shielded pairs.
 - e. RTD and Thermocouple Extension Cable:
 - 1) Continuous field to panel with no intermediate junction boxes or terminations.
 - 2) RTDs in motor windings are considered a 600-volt circuit.
 - 3) Terminate thermocouple extension wire directly to loop instrument.
3. Signal Switching:
 - a. Use dry circuit type relays or switches.
 - b. No interruption of 4 mA to 20 mA loops during switching.
 - c. Switching Transients in Associated Signal Circuit:
 - 1) 4 mA dc to 20 mA dc Signals: 0.2 mA, maximum.
 - 2) 1V dc to 5V dc Signals: 0.05V, maximum.
4. Relay Types: Reference Section 40 91 00, Instrumentation and Control Components, Part 2, Article Electrical Components.
5. Push-to-Test Circuitry: For each push-to-test indicating light, provide a fused push-to-test circuit.
6. Internal Panel Lights for Freestanding Panels:
 - a. Type: Switched 100-watt incandescent back-of-panel lights.
 - b. Quantity: One light for every 4 feet of panel width.
 - c. Mounting: Inside and in the top of back-of-panel area.
 - d. Protective metal shield for lights.
7. Service Outlets for Freestanding Panels:
 - a. Type: Three-wire, 120-volt, 15-ampere, GFCI GFCI duplex receptacles.
 - b. Quantity:
 - 1) Panels 4 Feet Wide and Smaller: One.
 - 2) Panels Larger than 4 Feet Wide: One for every 4 feet of panel width, two minimum per panel.
 - c. Mounting: Evenly spaced along back-of-panel area.

GRFF OZONE SYSTEM REPLACEMENT

8. Internal Panel Lights and Service Outlets for Smaller Panels:
 - a. Internal Panel Light: Switched 100-watt LED light.
 - b. Service Outlet:
 - 1) Breaker protected 120-volt, 15-amp, GFCI duplex receptacle: Required for panels. Refer to Control Panel Schedule in Article Supplements.

9. Standard Pushbutton Colors and Inscriptions:

- a. Use the following:

Tag Function	Inscription(s)	Color
OO	ON OFF	Black Black
OC	OPEN CLOSE	Black Black
OCA	OPEN CLOSE AUTO	Black Black Black
HOA	HAND OFF AUTO	Black Black Black
MA	MANUAL AUTO	Black Black
SS	START STOP	Black Black
RESET	RESET	Black
EMERGENCY STOP	EMERGENCY STOP	Red

- b. Lettering Color:
 - 1) Black on white and yellow buttons.
 - 2) White on black, red, and green buttons.

10. Standard Light Colors and Inscriptions:

- a. Use following color code and inscriptions for service legends and lens colors for indicating lights, unless otherwise noted in Supplement Instrument List:

Tag Function	Inscription(s)	Color
ON	ON	Green
OFF	OFF	Red
OPEN	OPEN	Green
CLOSED	CLOSED	Red

Tag Function	Inscription(s)	Color
LOW	LOW	Red
FAIL	FAIL	Red
HIGH	HIGH	Red
AUTO	AUTO	White
MANUAL	MANUAL	Yellow
LOCAL	LOCAL	White
REMOTE	REMOTE	Yellow

- b. Lettering Color:
- 1) Black on white and amber lenses.
 - 2) White on red and green lenses.

F. PIC Enclosure Internal Wiring:

1. Restrain by plastic ties or ducts or metal raceways.
2. Hinge Wiring: Secure at each end so bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve.
3. Arrange wiring neatly, cut to proper length, and remove surplus wire.
4. Provide abrasion protection for wire bundles that pass through holes or across edges of sheet metal.
5. Connections to Screw Type Terminals:
 - a. Locking-fork-tongue lugs.
 - b. Use manufacturer's recommended tool with required sized anvil to make crimp lug terminations.
 - c. Wires terminated in a crimp lug, maximum of one.
 - d. Lugs installed on a screw terminal, maximum of two.
6. Connections to Compression Clamp Type Terminals:
 - a. Strip, prepare, and install wires in accordance with terminal manufacturer's recommendations.
 - b. Wires installed in a compression screw and clamp, maximum of one for field wires entering enclosure, otherwise maximum of two.
7. Splicing and tapping of wires, allowed only at device terminals or terminal blocks.
8. Terminate 24V dc and analog signal circuits on separate terminal block from ac circuit terminal blocks.
9. Separate analog and dc circuits by at least 6 inches from ac power and control wiring, except at unavoidable crossover points and at device terminations.
10. Arrange wiring to allow access for testing, removal, and maintenance of circuits and components.

11. Plastic Wire Duct Fill: Do not exceed manufacturer's recommendations.
 12. Conductors Carrying Foreign Voltages within a Panel:
 - a. Route foreign voltage conductors into panel and land on a circuit blade disconnect type terminal block.
 - b. Use wire with pink insulation to identify foreign voltage circuits within panel from terminal block on. Do not use wires with pink insulation for any other purpose.
 13. Harness Wiring:
 - a. 120V ac: 14 AWG, MTW.
 - b. 24V dc: 16 AWG, MTW where individual conductors are used and Type TC shielded tray cable where shielded wire is used.
 14. Panelwork:
 - a. No exposed connections.
 - b. Allow adjustments to equipment to be made without exposing these terminals.
 - c. For power and control wiring operating above 80V ac or dc use covered channels or EMT raceways separate from low voltage signal circuits.
 15. Plastic Wire Ducts Color:
 - a. 120V ac: White.
 - b. 24V dc: Gray.
 - c. Communications Cables and Fiber Optic Jumpers: Orange.
 16. Provide a communications plastic wire duct for communications cables and fiber optic cables between the communications devices in control panel and communications raceways. Design plastic wire duct design to take into account the minimum bending radius of the communications cable.
 17. Make plastic wire ducts the same depth.
 18. Provide a minimum of 1-1/2 inches between plastic wire ducts and terminal blocks.
- G. Control Relay Arrangement: Install control relays associated with specific loops in same panel section as corresponding terminal blocks or side panels. Provide 20 percent space for future relays. Locate spare space in same sections as spare terminal blocks.
- H. Factory Finishing:
1. Furnish materials and equipment with manufacturer's standard finish system.
 2. Use specific color if indicated. Otherwise use manufacturer's standard finish color, or light gray if manufacturer has no standard color.
 3. Stainless Steel and Aluminum: Not painted.

GRFF OZONE SYSTEM REPLACEMENT

4. Steel Panels:
 - a. Sand panel and remove mill scale, rust, grease, and oil.
 - b. Fill imperfections and sand smooth.
 - c. Paint panel interior and exterior with one coat of epoxy coating metal primer, two finish coats of two-component type epoxy enamel.
 - d. Sand surfaces lightly between coats.
 - e. Dry Film Thickness: 3 mils, minimum.
 - f. Color: Blue.

2.13 CORROSION PROTECTION

A. Corrosion-Inhibiting Vapor Capsules:

1. Areas Where Required: Refer to Part 3, Article Protection.
2. Manufacturers and Products:
 - a. Northern Instruments; Model Zerust VC.
 - b. Hoffmann Engineering; Model A-HCI.

2.14 SOURCE QUALITY CONTROL

A. General:

1. Engineer may actively participate in many of the tests.
2. Engineer reserves right to test or retest specified functions.
3. Engineer's decision will be final regarding acceptability and completeness of testing.
4. Procedures, Forms, and Checklists:
 - a. Except for Unwitnessed Factory Test, conduct tests in accordance with, and documented on, Engineer accepted procedures, forms, and checklists.
 - b. Describe each test item to be performed.
 - c. Have space after each test item description for sign off by appropriate party after satisfactory completion.
5. Required Test Documentation: Test procedures, forms, and checklists signed by Engineer and Contractor.
6. Conducting Tests:
 - a. Provide special testing materials and equipment.
 - b. Wherever possible, perform tests using actual process variables, equipment, and data.
 - c. If not practical to test with real process variables, equipment, and data provide suitable means of simulation.
 - d. Define simulation techniques in test procedures.

- e. Test Format: Cause and effect.
 - 1) Person conducting test initiates an input (cause).
 - 2) Specific test requirement is satisfied if correct result (effect), occurs.

B. Unwitnessed Factory Acceptance Test:

- 1. Scope: Inspect and test PIC to ensure it is operational, ready for FAT.
- 2. Location: PIC Integrator's facility.
- 3. Integrated Test:
 - a. Interconnect and test PIC, except for primary elements and smaller panels.
 - b. Exercise and test functions.
 - c. Provide stand-alone testing of smaller panels.
 - d. Simulate inputs and outputs for primary elements, final control elements, and panels excluded from test.

C. Factory Acceptance Tests (FAT):

- 1. Notify Engineer of test schedule 4 weeks prior to start of test.
- 2. Scope:
 - a. Test entire PIC, with exception of primary elements, final control elements, and certain smaller panels, to demonstrate it is operational.
 - b. Refer to Supplement Control Panel Schedule in Article Supplements for list of panels for which FAT is required.
- 3. Location: PIC Integrator's facility.
- 4. Correctness of wiring from panel field terminals to PLC system input/output points and to panel components.
 - a. Simulate each discrete signal at terminal strip.
 - b. Simulate correctness of each analog signal using current source.
- 5. Operation of communications between PLCs and remote I/O and between PLCs and computers.
- 6. Operation of communications between the PLC system.
- 7. Loop-Specific Functions:
 - a. Demonstrate functions shown on P&IDs:
 - 1) One of each type function; for example, if there are filter backwash sequence control for several identical filters, demonstrate controls for one filter.
 - 2) One of each type of function in each panel; for example, but not limited to annunciator operation, controller operation, and recorder operation.
 - 3) All required and shown functions for 100 percent of loops.

GRFF OZONE SYSTEM REPLACEMENT

8. Nonloop-Specific Functions:
 - a. Capacity: Demonstrate that PIC systems have required spare capacity for expansion. Include tests for both storage capacity and processing capacity.
 - b. Timing: Include tests for timing requirements.
 - c. Diagnostics: Demonstrate online and offline diagnostic tests and procedures.
9. Correct deficiencies found and complete prior to shipment to Site.
10. Failed Tests:
 - a. Repeat and witnessed by Engineer.
 - b. With approval of Engineer, certain tests may be conducted by PIC Integrator and witnessed by Engineer as part of Operational Readiness Test.
11. Make following documentation available to Engineer at test site both before and during FAT:
 - a. Drawings, Specifications, Addenda, and Change Orders.
 - b. Master copy of FAT procedures.
 - c. List of equipment to be tested including make, model, and serial number.
 - d. Approved hardware Shop Drawings for equipment being tested.
 - e. Approved preliminary software documentation Submittal.
12. Daily Schedule for FAT:
 - a. Begin each day with meeting to review day's test schedule.
 - b. End each day with each meeting to review day's test results and to review or revise next day's test schedule.

PART 3 EXECUTION

3.01 EXAMINATION

- A. For equipment not provided by PIC Integrator, but that directly interfaces with PIC, verify the following conditions:
 1. Proper installation.
 2. Calibration and adjustment of positioners and I/P transducers.
 3. Correct control action.
 4. Switch settings and dead bands.
 5. Opening and closing speeds and travel stops.
 6. Input and output signals.

3.02 INSTALLATION

- A. Material and Equipment Installation: Follow manufacturers' installation instructions, unless otherwise indicated or directed by Engineer.
- B. Wiring connected to PIC components and assemblies, including power wiring in accordance with requirements in Section 26 05 05, Conductors.
- C. Electrical Raceways: As specified in Section 26 05 33, Raceway and Boxes.
- D. Mechanical Systems:
 - 1. Copper and Stainless Steel Tubing Support: Continuously supported by aluminum tubing raceway system.
 - 2. Plastic Tubing Support: Except as shown on the Drawings, provide continuous support in conduit or by aluminum tubing raceway system.
 - 3. Install conduit for plastic tubing and tubing raceways parallel with, or at right angles to, structural members of buildings. Make vertical runs straight and plumb.
 - 4. Tubing and Conduit Bends:
 - a. Tool-formed without flattening, and of same radius.
 - b. Bend Radius: Equal to or larger than conduit and tubing manufacturer's recommended minimum bend radius.
 - c. Slope instrument connection tubing in accordance with installation details.
 - d. Do not run liquid filled instrument tubing immediately over or within a 3-foot plan view clearance of electrical panels, motor starters, or mechanical mounting panel without additional protection. Where tubing must be located in these zones, shield electrical device to prevent water access to electrical equipment.
 - e. Straighten coiled tubing by unrolling on flat surface. Do not pull to straighten.
 - f. Cut tubing square with sharp tubing cutter. Deburr cuts and remove chips. Do not gouge or scratch surface of tubing.
 - g. Blow debris from inside of tubing.
 - h. Make up and install fittings in accordance with manufacturer's recommendations. Verify make up of tube fittings with manufacturer's inspection gauge.
 - i. Use lubricating compound or TFE tape on stainless steel threads to prevent seizing or galling.
 - j. Run tubing to allow but not limited to, clear access to doors, controls and control panels; and to allow for easy removal of equipment.
 - k. Provide separate support for components in tubing runs.

GRFF OZONE SYSTEM REPLACEMENT

- l. Supply expansion loops and use adapters at pipe, valve, or component connections for proper orientation of fitting.
- m. Keep tubing and conduit runs at least 12 inches from hot pipes.
- n. Locate and install tubing raceways in accordance with manufacturer's recommendations. Locate tubing to prevent spillage, overflow, or dirt from above.
- o. Securely attach tubing raceways to building structural members.
5. Enclosure Lifting Rings: Remove rings following installation and plug holes.

3.03 FIELD QUALITY CONTROL

A. General:

1. Coordinate PIC testing with Owner and affected Subcontractors.
2. Notify Engineer of Performance Test schedule 4 weeks prior to start of test.
3. Engineer may actively participate in tests.
4. Engineer reserves right to test or retest specified functions.
5. Engineer's decision will be final regarding acceptability and completeness of testing.

B. Onsite Supervision:

1. Require PIC Integrator to observe PIC equipment installation to extent required in order to provide Certificates of Proper Installation.
2. Require PIC site representative to supervise and coordinate onsite PIC activities.
3. Require PIC site representative to be onsite while onsite work covered by this section and PIC subsystems is in progress.

C. Leak Tests: During preparation for testing, conduct leak tests in accordance with Section 40 80 01, Process Piping Leakage Testing.

D. Testing Sequence:

1. Provide Operational Readiness Tests, Functional Demonstration Tests, and Performance Tests for facilities as required to support construction and startup of plant.
2. Refer to Section 01 31 13, Project Coordination, for a definition of project milestones.
3. Refer to Section 01 91 14, Equipment Testing and Facility Startup, for overall testing requirements.
4. Completion: When tests (except Functional Demonstration Test) have been completed and required test documentation has been accepted.

E. Testing:

1. Prior to Facility Startup and Functional Demonstration Evaluation period for each facility, inspect, test, and document that associated PIC equipment is ready for operation.
2. Operational Readiness Test (ORT):
 - a. Loop/Component Inspections and Tests:
 - 1) These inspections and tests will be spot checked by Engineer.
 - 2) Check PIC for proper installation, calibration, and adjustment on loop-by-loop and component-by-component basis.
 - 3) Provide space on forms for signoff by PIC Integrator.
 - 4) Use loop status report to organize and track inspection, adjustment, and calibration of each loop and include the following:
 - a) Project name.
 - b) Loop number.
 - c) Tag number for each component.
 - d) Checkoffs/Signoffs for Each Component:
 - (1) Tag/identification.
 - (2) Installation.
 - (3) Termination wiring.
 - (4) Termination tubing.
 - (5) Calibration/adjustment.
 - e) Checkoffs/Signoffs for the Loop:
 - (1) Panel interface terminations.
 - (2) I/O interface terminations with PLCs.
 - f) I/O Signals for PLCs are Operational: Received/sent, processed, adjusted.
 - g) Total loop operational.
 - h) Space for comments.
 - 5) Component calibration sheet for each active I&C component (except simple hand switches, lights, gauges, and similar items) and each PLCs I/O module and include the following:
 - a) Project name.
 - b) Loop number.
 - c) Component tag number or I/O module number.
 - d) Component code number for I&C elements.
 - e) Manufacturer for I&C elements.
 - f) Model number/serial number for I&C elements.

- g) Summary of Functional Requirements; For Example:
 - (1) Indicators and recorders, scale, and chart ranges.
 - (2) Transmitters/converters, input and output ranges.
 - (3) Computing elements' function.
 - (4) Controllers, action (direct/reverse) and control modes (P, I, D).
 - (5) Switching elements, unit range, differential (fixed/adjustable), reset (auto/manual).
 - (6) I/O Modules: Input or output.
 - h) Calibrations, for example, but not limited to:
 - (1) Analog Devices: Actual inputs and outputs at 0, 10, 50, and 100 percent of span, rising and falling.
 - (2) Discrete Devices: Actual trip points and reset points.
 - (3) Controllers: Mode settings (P&ID).
 - (4) I/O Modules: Actual inputs or outputs of 0, 10, 50, and 100 percent of span, rising and falling.
 - (5) Space for comments.
 - b. Maintain loop status reports, valve adjustment sheets, and component calibration sheets at Site, and make them available to Engineer at all times.
 - c. Engineer reviews loop status sheets and component calibration sheets and spot-check their entries periodically, and upon completion of Preparation for Testing. Correct deficiencies found.
 - d. FDT-Repeat:
 - 1) Repeat FDT onsite with installed PIC equipment and software.
 - 2) As listed in PIC subsections, certain portions of FDT may not require retesting.
 - 3) Use FDT test procedures as basis for this test.
 - 4) In general, this test shall not require witnessing. However, portions of this test, as identified by Engineer during original FDT shall be witnessed.
 - e. Forms: See Loop Status Report, Instrument Calibration Sheet, and I&C Valve Adjustment Sheet referenced in Article Supplements.
- 3. Functional Demonstration Testing (FDT):
 - a. Scope: Prior to startup test period, inspect, test, and document that PIC system and associated PIC system equipment and software are ready for operation.
 - b. Refer to PIC subsections for additional requirements.
 - c. Completed when Operational Readiness Test has been conducted, and Engineer has spot-checked associated test forms and checklists in field.

4. Required Test Documentation: Test procedures, forms, and checklists. Signed by Engineer and Contractor except for Operational Readiness Test items signed only by Contractor.

- F. Performance Test During and After Facility Startup: Reference Section 01 91 14, Equipment Testing and Facility Startup.

3.04 MANUFACTURER'S SERVICES

- A. Manufacturer's Representative: As required by each PIC subsection.
- B. See Section 01 43 33, Manufacturers' Field Services.

3.05 TRAINING

- A. General:
 1. Provide an integrated training program for Owner's personnel.
 2. Perform training to meet specific needs of Owner's personnel.
 3. Include training sessions, classroom and field, for managers, engineers, operators, and maintenance personnel.
 4. Provide instruction on three working shift(s) as needed to accommodate the Owner's personnel schedule.
 5. Owner reserves the right to reuse videotapes of training sessions.
- B. Operations and Maintenance Training:
 1. General:
 - a. Refer to specific requirements specified in PIC Subsections.
 - b. Include review of O&M data and survey of spares, expendables, and test equipment.
 - c. Use equipment similar to that provided.
 - d. Unless otherwise specified in PIC subsections, provide training suitable for instrument technicians with at least a 2-year associate engineering or technical degree, or equivalent education and experience in electronics, instrumentation, or digital systems.
 2. Operations Training: For Owner's operations personnel on operation of I&C components.
 - a. Training Session Duration: 4 hours per session.
 - b. Number of Training Sessions: Three sessions.
 - c. Location: Project Site.
 - d. Course Objective: Develop skills needed to use I&C components and functions to monitor and control the plant on a day-to-day basis.

GRFF OZONE SYSTEM REPLACEMENT

- e. Content: Conduct training on loop-by-loop basis.
 - 1) Loop Functions: Understanding of loop functions, including interlocks for each loop.
 - 2) Loop Operation: For example, adjusting process variable setpoints, AUTO/MANUAL control transfer, AUTO and MANUAL control, annunciator acknowledgement and resetting.
 - 3) Interfaces with PIC subsystems.
- 3. Maintenance Training:
 - a. Training Session Duration: 4 hour instructor days.
 - b. Number of Training Sessions: Three.
 - c. Location: Project Site.
 - d. Course Objective: Develop skills needed for routine maintenance of PIC.
 - e. Content: Provide training for each type of component and function provided.
 - 1) Loop Functions: Understanding details of each loop and how they function.
 - 2) Component calibration.
 - 3) Adjustments: For example, controller tuning constants, current switch trip points, and similar items.
 - 4) Troubleshooting and diagnosis for equipment and software.
 - 5) Replacing lamps, chart paper, and fuses.
 - 6) I&C components removal and replacement.
 - 7) Periodic preventive maintenance.

3.06 CLEANING

- A. Upon completion of Work, remove materials, scraps, and debris from interior and exterior of equipment.

3.07 PROTECTION

- A. Use corrosion-inhibiting vapor capsules in enclosures to protect electrical, instrumentation, and control devices, including spare parts, from corrosion.
- B. Periodically replace capsules based on capsule manufacturer's recommendations.

3.08 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are a part of this specification:
 - 1. PLC I/O Schedule.
 - 2. Control Panel Schedule.

3. Preparation for Testing and Functional Test Forms:
 - a. Loop Status Report: Each sheet shows status of instruments on a loop. Also, gives functional description for loop.
 - b. Instrument Calibration Sheet: Shows details on each instrument (except simple hand switches, lights, and similar items).
 - c. I&C Valve Adjustment Sheet: Shows details for installation, adjustment, and calibration of a given valve.
 - d. Functional Demonstration Test Sheet: Describe Functional Demonstration Test for a given loop.

END OF SECTION

PLC I/O SCHEDULE

Tag No.	Description	Process Variable	On Status	Function	Control Panel	PLC	I/O Type	P&ID	Notes
ZS36051	Sample Station 1 Door Switch		OPEN	ALARM	CP-36001	11000	DI	08-I-112	
HS36101	Sample Station 1 R1 Sample Pump		REM	STATUS	CP-36001	11000	DI	08-I-112	
YL36101	Sample Station 1 R1 Sample Pump		ON	STATUS	CP-36001	11000	DI	08-I-112	
PMP36101	Sample Station 1 R1 Sample Pump		RUN	CONTROL	CP-36001	11000	DO	08-I-112	
AIT36121	Sample Station 1 R1 Ozone Concentration	O3			CP-36001	11000	AI	08-I-112	
FIT36131A	Sample Station 1 R1 Flow	FLOW			CP-36001	11000	AI	08-I-112	
HS36501	Sample Station 1 R5 Sample Pump		REM	STATUS	CP-36001	11000	DI	08-I-112	
YL36501	Sample Station 1 R5 Sample Pump		ON	STATUS	CP-36001	11000	DI	08-I-112	
PMP36501	Sample Station 1 R5 Sample Pump		RUN	CONTROL	CP-36001	11000	DO	08-I-112	
AIT36521	Sample Station 1 R5 Ozone Concentration	O3			CP-36001	11000	AI	08-I-112	
FIT36531A	Sample Station 1 R5 Flow	FLOW			CP-36001	11000	AI	08-I-112	
ZS36052	Sample Station 2 Door Switch		OPEN	ALARM	CP-36002	11000	DI	08-I-113	

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Process Variable	On Status	Function	Control Panel	PLC	I/O Type	P&ID	Notes
HS36102	Sample Station 2 R1 Sample Pump		REM	STATUS	CP-36002	11000	DI	08-I-113	
YL36102	Sample Station 2 R1 Sample Pump		ON	STATUS	CP-36002	11000	DI	08-I-113	
PMP36102	Sample Station 2 R1 Sample Pump		RUN	CONTROL	CP-36002	11000	DO	08-I-113	
AIT36122	Sample Station 2 R1 Ozone Concentration	O3			CP-36002	11000	AI	08-I-113	
FIT36132A	Sample Station 2 R1 Flow	FLOW			CP-36002	11000	AI	08-I-113	
HS36502	Sample Station 2 R5 Sample Pump		REM	STATUS	CP-36002	11000	DI	08-I-113	
YL36502	Sample Station 2 R5 Sample Pump		ON	STATUS	CP-36002	11000	DI	08-I-113	
PMP36502	Sample Station 2 R5 Sample Pump		RUN	CONTROL	CP-36002	11000	DO	08-I-113	
AIT36522	Sample Station 2 R5 Ozone Concentration	O3			CP-36002	11000	AI	08-I-113	
FIT36532A	Sample Station 2 R5 Flow	FLOW			CP-36002	11000	AI	08-I-113	
ZS36053	Sample Station 3 Door Switch		OPEN	ALARM	CP-36003	11000	DI	08-I-114	
HS36103	Sample Station 3 R1 Sample Pump		REM	STATUS	CP-36003	11000	DI	08-I-114	

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Process Variable	On Status	Function	Control Panel	PLC	I/O Type	P&ID	Notes
YL36103	Sample Station 3 R1 Sample Pump		ON	STATUS	CP-36003	11000	DI	08-I-114	
PMP36103	Sample Station 3 R1 Sample Pump		RUN	CONTROL	CP-36003	11000	DO	08-I-114	
AIT36123	Sample Station 3 R1 Ozone Concentration	O3			CP-36003	11000	AI	08-I-114	
FIT36133A	Sample Station 3 Flow	FLOW			CP-36003	11000	AI	08-I-114	
HS36503	Sample Station 3 R5 Sample Pump		REM	STATUS	CP-36003	11000	DI	08-I-114	
YL36503	Sample Station 3 R5 Sample Pump		ON	STATUS	CP-36003	11000	DI	08-I-114	
PMP36503	Sample Station 3 R5 Sample Pump		RUN	CONTROL	CP-36003	11000	DO	08-I-114	
AIT36523	Sample Station 3 R5 Ozone Concentration	O3			CP-36003	11000	AI	08-I-114	
FIT36533A	Sample Station 3 R5 Flow	FLOW			CP-36003	11000	AI	08-I-114	
ZS36054	Sample Station 4 Door Switch		OPEN	ALARM	CP-36004	11000	DI	08-I-115	
HS36104	Sample Station 4 R1 Sample Pump		REM	STATUS	CP-36004	11000	DI	08-I-115	
YL36104	Sample Station 4 R1 Sample Pump		ON	STATUS	CP-36004	11000	DI	08-I-115	
PMP36104	Sample Station 4 R1 Sample Pump		RUN	CONTROL	CP-36004	11000	DO	08-I-115	

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Process Variable	On Status	Function	Control Panel	PLC	I/O Type	P&ID	Notes
AIT36124	Sample Station 4 R1 Ozone Concentration	O3			CP-36004	11000	AI	08-I-115	
FIT36134A	Sample Station 4 R1 Flow	FLOW			CP-36004	11000	AI	08-I-115	
HS36504	Sample Station 4 R5 Sample Pump		REM	STATUS	CP-36004	11000	DI	08-I-115	
YL36504	Sample Station 4 R5 Sample Pump		ON	STATUS	CP-36004	11000	DI	08-I-115	
PMP36504	Sample Station 4 R5 Sample Pump		RUN	CONTROL	CP-36004	11000	DO	08-I-115	
AIT36524	Sample Station 4 R5 Ozone Concentration	O3			CP-36004	11000	AI	08-I-115	
FIT36534A	Sample Station 4 R5 Flow	FLOW			CP-36004	11000	AI	08-I-115	
ZS36055	Sample Station 5 Door Switch		OPEN	ALARM	CP-36005	11000	DI	08-I-116	
HS36105A	Sample Station 5 R1 Sample Pump		REM	STATUS	CP-36005	11000	DI	08-I-116	
YL36105A	Sample Station 5 R1 Sample Pump		ON	STATUS	CP-36005	11000	DI	08-I-116	
PMP36105A	Sample Station 5 R1 Sample Pump		RUN	CONTROL	CP-36005	11000	DO	08-I-116	
HS36105B	Sample Station 5 R1 Sample Pump		REM	STATUS	CP-36005	11000	DI	08-I-116	

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Process Variable	On Status	Function	Control Panel	PLC	I/O Type	P&ID	Notes
YL36105B	Sample Station 5 R1 Sample Pump		ON	STATUS	CP-36005	11000	DI	08-I-116	
PMP36105B	Sample Station 5 R1 Sample Pump		RUN	CONTROL	CP-36005	11000	DO	08-I-116	
HS36505A	Sample Station 5 R5 Sample Pump		REM	STATUS	CP-36005	11000	DI	08-I-116	
YL36505A	Sample Station 5 R5 Sample Pump		ON	STATUS	CP-36005	11000	DI	08-I-116	
PMP36505A	Sample Station 5 R5 Sample Pump		RUN	CONTROL	CP-36005	11000	DO	08-I-116	
HS36505B	Sample Station 5 R5 Sample Pump		REM	STATUS	CP-36005	11000	DI	08-I-116	
YL36505B	Sample Station 5 R5 Sample Pump		ON	STATUS	CP-36005	11000	DI	08-I-116	
PMP36505B	Sample Station 5 R5 Sample Pump		RUN	CONTROL	CP-36005	11000	DO	08-I-116	
HS2905	Sample Station 5 valve		REM	STATUS	CP-36005	11000	DI	08-I-116	
EDV2905	Sample Station 5 Valve		OPEN	CONTROL	CP-36005	11000	DO	08-I-116	
HS2906	Sample Station 5 Valve		REM	STATUS	CP-36005	11000	DI	08-I-116	
EDV2906	Sample Station 5 Valve		OPEN	CONTROL	CP-36005	11000	DO	08-I-116	
HS2915	Sample Station 5 Valve		REM	STATUS	CP-36005	11000	DI	08-I-116	
EDV2915	Sample Station 5 Valve		OPEN	CONTROL	CP-36005	11000	DO	08-I-116	
HS2916	Sample Station 5 Valve		REM	STATUS	CP-36005	11000	DI	08-I-116	

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Process Variable	On Status	Function	Control Panel	PLC	I/O Type	P&ID	Notes
EDV2916	Sample Station 5 Valve		OPEN	CONTROL	CP-36005	11000	DO	08-I-116	
AIT2900	Sample Station 5 pH Concentration	pH			CP-36005	11000	AI	08-I-116	
AIT2903	Sample Station 5 CL2 Concentration	CL2			CP-36005	11000	AI	08-I-116	
YA2903	Sample Station 5 CL2 Analyzer		FAULT	ALARM	CP-36005	11000	DI	08-I-116	
AIT2910	Sample Station 5 pH Concentration	pH			CP-36005	11000	AI	08-I-116	
AIT2913	Sample Station 5 CL2 Concentration	CL2			CP-36005	11000	AI	08-I-116	
YA2913	Sample Station 5 CL2 Analyzer		FAULT	ALARM	CP-36005	11000	DI	08-I-116	
AIT2920	Sample Station 5 pH Concentration	pH			CP-36005	11000	AI	08-I-116	
AIT2921	Sample Station 5 CL2 Concentration	CL2			CP-36005	11000	AI	08-I-116	

CONTROL PANEL SCHEDULE

Panel No.	Service	Mounting	NEMA	Dimensions H W D	FA T	Space Heater	Serv. Lights, Outlets	Environment	SS
CP-11000	Headworks Control Panel	Freestanding modular enclosure	12	108" x 36" x 24"	Yes	No	Yes	Inside	No
CP-36001	Sample Station 1 Control Panel	Back panel only	12	60" x 20"	Yes	No	Yes	Inside	No
CP-36002	Sample Station 2 Control Panel	Back panel only	12	60" x 20"	Yes	No	Yes	Inside	No
CP-36003	Sample Station 3 Control Panel	Back panel only	12	60" x 20"	Yes	No	Yes	Inside	No
CP-36004	Sample Station 4 Control Panel	Back panel only	12	60" x 20"	Yes	No	Yes	Inside	No
CP-36005	Sample Station 5 Control Panel	Back panel only	12	60" x 20"	Yes	No	Yes	Inside	No
Column Descriptions: FAT: Factory acceptance test required for assembled back panels and side panels. Dimensions: Space available for Headworks Control Panel. For Sample Station Control Panels, dimensions are for back panel. SS: Stainless Steel.									

GRFF OZONE SYSTEM REPLACEMENT

JACOBS

LOOP STATUS REPORT—EXAMPLE FORMAT

Rev.06.05.92

Project Name: <i>Newport News WTP</i>					Project No. <i>WDC23456.C1</i>		
FUNCTIONAL REQUIREMENTS:							
<i>1. Measure, locally indicate, and transmit RAS flow to LP-10.</i>							
<i>2. At LP-10 indicate flow and provide flow control by modulation of FCV-10-2.</i>							
<i>3. Provide high RAS flow alarm on LP-10.</i>							
COMPONENT STATUS (Check and initial each item when complete)							
Tag Number	Delivered	Tag ID Checked	Installation	Termination Wiring	Termination Tubing	Calibration	
<i>FE/FIT-10-2</i>	<i>Jan-12-90 DWM</i>	<i>Jan-12-90 DWM</i>	<i>Feb-7-90 DWM</i>	<i>Mar-5-90 DWM</i>	<i>N.A.</i>	<i>May-6-90 VDA</i>	
<i>FIC-10-2</i>	<i>Jan-12-90 DWM</i>	<i>Jan-12-90 DWM</i>	<i>Mar-5-90 DWM</i>	<i>Apr-4-90 DWM</i>		<i>May-4-90 VDA</i>	
<i>FSH-10-2</i>	<i>Jan-12-90 DWM</i>	<i>Jan-12-90 DWM</i>	<i>Mar-5-90 DWM</i>	<i>Apr-4-90 DWM</i>		<i>May-7-90 VDA</i>	
<i>FAH-10-2</i>	<i>Jan-12-90 DWM</i>	<i>Jan-12-90 DWM</i>	<i>Mar-5-90 DWM</i>	<i>Apr-4-90 DWM</i>		<i>May-7-90 VDA</i>	
<i>FCV-10-2</i>	<i>Mar-2-90 DWM</i>	<i>Mar-2-90 DWM</i>	<i>Apr-20-90 DWM</i>	<i>Apr-30-90 DWM</i>		<i>May-16-90 VDA</i>	
REMARKS: <i>None.</i>							
Loop Ready for Operation		By: <i>D.W. Munzer</i>		Date: <i>May-18-90</i>		Loop No.: <i>10-2</i>	

GRFF OZONE SYSTEM REPLACEMENT

JACOBS

INSTRUMENT CALIBRATION SHEET—EXAMPLE—ANALYZER/TRANSMITTER

Rev.06.05.92

COMPONENT			MANUFACTURER				PROJECT					
Code: A7			Name: Leeds & Northrup				Number: WDC30715.B2					
Name: pH Element & Analyzer/Transmitter			Model: 12429-3-2-1-7		Serial #: 11553322		Name: UOSA AWT PHASE 3					
FUNCTIONS												
Indicate? Y Record? N	RANGE	VALUE	UNITS	COMPUTING FUNCTIONS? N			CONTROL? N					
	Chart:			Describe:			Action? direct / reverse Modes? P / I / D					
Transmit/ Convert? Y	Scale:	1-14	pH units				SWITCH? N					
	Input:	1-14	pH units				Unit Range:					
	Output:	4-20	mA dc				Differential: fixed/adjustable					
							Reset? automatic / manual					
ANALOG CALIBRATIONS							DISCRETE CALIBRATIONS				Note No.	
REQUIRED			AS CALIBRATED				REQUIRED			AS CALIBRATED		
Input	Indicated	Output	Increasing Input		Decreasing Input		Number	Trip Point	Reset Pt.	Trip Point		Reset Pt.
			Indicated	Output	Indicated	Output		(note rising or falling)		(note rising or falling)		
1.0	1.0	4.0	1.0	4.0	1.0	3.9	1.	N.A.		N.A.		
2.3	2.3	5.6	2.2	5.5	2.3	5.6	2.					
7.5	7.5	12.0	7.5	11.9	7.5	12.0	3.					
12.7	12.7	18.4	12.7	18.3	12.6	18.3	4.					
14.0	14.0	20.0	14.0	20.0	14.0	20.0	5.					
CONTROL MODE SETTINGS:			P: N.A.	I:	D:		6.					
#	NOTES:									Component Calibrated and Ready for Start-up By: J.D. Sewell Date: Jun-6-92 Tag No.: AIT-12-6[pH]		
	1. Need to recheck low pH calibration solutions.											

GRFF OZONE SYSTEM REPLACEMENT

JACOBS

I&C VALVE ADJUSTMENT SHEET—EXAMPLE

Rev.06.05.92

PARTS	Project Name: <i>SFO SEWPCP</i>	Project Number: <i>SFO10145.G2</i>			
Body	Type: <i>Vee-Ball</i>	Mfr: <i>Fisher Controls</i>			
	Size: <i>4-inch</i>	Model: <i>1049763-2</i>			
	Line Connection: <i>159 # ANSI Flanges</i>	Serial #: <i>1003220</i>			
Operator	Type: <i>Pneumatic Diaphragm</i>	Mfr: <i>Fisher Controls</i>			
	Action: <i>Linear – Modulated</i>	Model: <i>4060D</i>			
	Travel: <i>3-inch</i>	Serial #: <i>2007330</i>			
Positioner	Input Signal: <i>3-15 psi</i>	Mfr: <i>Fisher Controls</i>			
	Action: <i>Direct - air to open</i>	Model: <i>20472T</i>			
	Cam: <i>Equal percentage</i>	Serial #: <i>102010</i>			
Pilot	Action:	Mfr:			
Solenoid	Rating: <i>None</i>	Model: Serial #:			
I/P Converter	Input: <i>4-20 mA dc</i>	Mfr: <i>Taylor</i>			
	Output: <i>3-15 psi</i>	Model: <i>10-T-576-3</i>			
	Action: <i>Direct</i>	Serial #: <i>1057-330</i>			
Position Switch	Settings: <i>Closed / Open 5 deg, rising</i>	Mfr: <i>National Switch</i>			
	Contacts: <i>Close / Close</i>	Model: <i>1049-67-3</i>			
		Serial #: <i>156 &157</i>			
Power Supply	Type: <i>Pneumatic</i>	Air Set Mfr: <i>Air Products</i>			
	Potential: <i>40 psi</i>	Model: <i>3210D</i>			
		Serial #: <i>1107063</i>			
ADJUSTMENTS	Initial	Date	VERIFICATION	Initial	Date
Air Set	<i>JDS</i>	<i>Jun-06-92</i>	Valve Action	<i>JDS</i>	<i>Jun-03-92</i>
Positioner	<i>JDS</i>	<i>Jun-06-92</i>	Installation	<i>JDS</i>	<i>Jun-03-92</i>
Position Switches	<i>JDS</i>	<i>Jun-06-92</i>	Wire Connection	<i>JDS</i>	<i>Jun-04-92</i>
I/P Converter	<i>JDS</i>	<i>Jun-07-92</i>	Tube Connection	<i>JDS</i>	<i>Jun-04-92</i>
Actual Speed	<i>JDS</i>	<i>Jun-07-92</i>			
REMARKS: <i>Valve was initially installed backwards.</i>				Valve Ready for Start-up	
<i>Observed to be correctly installed May-25-92</i>				By: <i>J.D. Sewell</i>	
				Date: <i>Jun-07-92</i>	
				Tag No.: <i>FCV-10-2-1</i>	

GRFF OZONE SYSTEM REPLACEMENT

JACOBS

FUNCTIONAL DEMONSTRATION TEST SHEET - EXAMPLE

Rev.06.05.92

Project Name: <i>SFO SEWPCP Plant Expansion</i>			Project No.: <i>SFO12345.C1</i>																									
Demonstration test(s): For each functional Requirement of the loop: (a) List and number the requirement. (b) Briefly describe the demonstration test. (c) Cite the results that will verify the required performance. (d) Provide space for signoff.																												
1. MEASURE EFFLUENT FLOW																												
<i>1.a With no flow, water level over weir should be zero and</i>																												
<i>FIT indicator should read zero.</i>			<i>Jun-20-92 BDG</i>																									
2. FLOW INDICATION AND TRANSMISSION TO LP & CCS																												
<i>With flow, water level and FIT indicator should be related by expression</i>																												
<i>$Q(\text{MGD}) = 429 \cdot H^{2/3}$ (H = height in inches of water over weir).</i>																												
<i>Vary H and observe that following.</i>																												
<i>2.a Reading of FIT indicator.</i>			<i>Jun-6-92 BDG</i>																									
<i>2.b Reading is transmitted to FI on LP-521-1</i>			<i>Jun-6-92 BDG</i>																									
<i>2.c Reading is transmitted and displayed to CCS.</i>			<i>Jun-6-92 BDG</i>																									
<table border="1"> <tr> <td><i>H(measured)</i></td> <td><i>0</i></td> <td><i>5</i></td> <td><i>10</i></td> <td><i>15</i></td> </tr> <tr> <td><i>Q(computed)</i></td> <td><i>0</i></td> <td><i>47.96</i></td> <td><i>135.7</i></td> <td><i>251.7</i></td> </tr> <tr> <td><i>Q(FIT indicator)</i></td> <td><i>0</i></td> <td><i>48.1</i></td> <td><i>137</i></td> <td><i>253</i></td> </tr> <tr> <td><i>Q(LI on LP-521-1)</i></td> <td><i>0</i></td> <td><i>48.2</i></td> <td><i>138</i></td> <td><i>254</i></td> </tr> <tr> <td><i>Q(display by CCS)</i></td> <td><i>0</i></td> <td><i>48.1</i></td> <td><i>136.2</i></td> <td><i>252.4</i></td> </tr> </table>				<i>H(measured)</i>	<i>0</i>	<i>5</i>	<i>10</i>	<i>15</i>	<i>Q(computed)</i>	<i>0</i>	<i>47.96</i>	<i>135.7</i>	<i>251.7</i>	<i>Q(FIT indicator)</i>	<i>0</i>	<i>48.1</i>	<i>137</i>	<i>253</i>	<i>Q(LI on LP-521-1)</i>	<i>0</i>	<i>48.2</i>	<i>138</i>	<i>254</i>	<i>Q(display by CCS)</i>	<i>0</i>	<i>48.1</i>	<i>136.2</i>	<i>252.4</i>
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Forms/Sheets Verified	By	Date	Loop Accepted By Owner																									
Loop Status Report	<i>J.D. Sewell</i>	<i>May-18-92</i>	By: <i>J.D. Smith</i>																									
Instrument Calibration Sheet	<i>J.D. Sewell</i>	<i>May-18-92</i>	Date: <i>Jun-6-92</i>																									
I&C Valve Calibration Sheet	<i>N.A.</i>																											
Functional Demonstration Test	By	Date																										
Performed	<i>J. Blow MPSDC Co.</i>	<i>Jun-6-92</i>																										
Witnessed	<i>B. DeGlanville</i>	<i>Jun-6-92</i>	Loop No.: <i>30-12</i>																									

**SECTION 40 91 00
INSTRUMENTATION AND CONTROL COMPONENTS**

PART 1 GENERAL

1.01 SUMMARY

- A. This section gives general requirements for instrumentation and control components.

PART 2 PRODUCTS

2.01 GENERAL

- A. Article Mechanical Systems Components covers requirements of mechanical PIC components that are not specifically referenced by Section 40 90 00, Instrumentation and Control for Process Systems, Instrument Lists or Data Sheets.
- B. Article Electrical Components covers requirements for electrical PIC components that are not specifically referenced by Section 40 90 00, Instrumentation and Control for Process Systems, Instrument Lists or Data Sheets.
- C. All other Part 2 Articles cover components that are referenced by Instrument Lists or Data Sheets in Section 40 90 00, Instrumentation and Control for Process Systems, or by specific component numbers in other PIC subsections.
- D. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 - 1. Use or reuse of components and materials without a traceable certification is prohibited.
- E. Contractor shall provide new instrumentation and replace all existing instrumentation with new instrumentation as indicated on design drawings and specifications and listed in the Instrument List in Article Supplements. New instruments shall:
 - 1. Replace existing instruments in like for like fashion.

GRFF OZONE SYSTEM REPLACEMENT

2. Be modern versions of instrument being replaced and shall be actively sold and supported by the manufacturer for the foreseeable future. No replacement instruments designated as approaching or entering end-of-life will be accepted.
 3. At a minimum, meet or exceed the accuracy, repeatability, functionality of the existing instrument being replaced.
 4. Be as similar as possible to existing equipment in terms of style, process connection, and installation.
- F. Unless otherwise noted on the Contract Drawings, install new replacement instruments in similar fashion to existing instruments to avoid the necessity of modifying existing installations and/or process connections, and so that the reuse of existing conductors may be maximized.
1. If replacement instrument with like for like installation footprint cannot be provided, it is the responsibility of the contractor to modify the installation and/or process connection as required to meet the intended functionality of the instrument in accordance with manufacturer's recommendations and as indicated in design specifications and drawings.
 2. Where existing conductors are unable to be reused or are unsuitable for new instrument connections, the Contractor shall be responsible for providing and installing new conductors to maintain instrument functionality as required.
- G. Contractor shall provide and install new conductors as required for new instruments and equipment.
- H. Contractor shall install the Ozone System Supplier (OSS) provided equipment listed in PART 3 – Veolia Power Supply Unit Procurement Proposal and Control Panel Procurement Proposal, Section 44 44 56.10 Ozone System Instruments.
- I. Contractor shall install instrumentation provided with package systems. Refer to Sections associated with package systems and to design drawings.

2.02 MECHANICAL SYSTEMS COMPONENTS

- A. Flow Element, Rotameter, Purge:
1. For air or water service, unless otherwise noted.
 2. Materials: Glass tube, fiberglass body, stainless steel float, nylon ball check valve.
 3. Direct-Reading Scale Length: 2-1/2 inches, minimum.

GRFF OZONE SYSTEM REPLACEMENT

4. Scale Ranges: 0 scfh to 2.5 scfh for air service or 0 gph to 10 gph for water service.
 5. Integral inlet needle valves.
 6. Integral differential pressure regulators:
 - a. For water service.
 - b. For air service for level ranges greater than 10 feet of water.
 7. Rotameters for water service.
 8. Manufacturers and Products:
 - a. Fischer & Porter; Series 10A3130.
 - b. Brooks; Series DS-1350.
- B. Manifold, Three-Valve Equalizing:
1. Type: For isolation and equalization of differential pressure transducers.
 2. Materials: Stainless steel.
 3. Manufacturers and Product:
 - a. Anderson, Greenwood and Co.; Type M1.
 - b. Evans.
- C. Pressure Gauge: For other than process variable measurement.
1. Dial Size: Nominal 2-inch dial size.
 2. Accuracy: 2 percent of span.
 3. Scale Range: Such that normal operating pressure lies between 50 percent and 80 percent of scale range.
 4. Connection: 1/4-inch NPT through bottom, unless otherwise noted.
 5. Manufacturers and Products:
 - a. Ashcroft Utility; Gauge Series 1000.
 - b. Marsh; Standard Gauge Series.
 - c. Ametek U.S.; Gauge Series P500.
 - d. Acculite; Series 2000.
- D. Valve, Needle:
1. Materials: Brass, stainless steel, PVC, or CPCV, as recommended by manufacturer for designated service, unless otherwise shown on the Drawings.
 2. Size: 0.020-inch orifice.
 3. Manufacturers and Products:
 - a. Whitey; Model 21RF2.
 - b. Hoke; 3700 Series.

GRFF OZONE SYSTEM REPLACEMENT

E. ON/OFF Valves:

1. Type: Ball valve.
2. Materials: Brass, stainless steel, PVC, or CPCV, as recommended by manufacturer for designated service, unless otherwise shown on the Drawings.
3. Manufacturers and Products:
 - a. Whitey; Series 41 through Series 43.
 - b. Hoke; Flomite 7100 Series.

F. Regulating Valves:

1. Type: Needle valves, with regulating stems and screwed bonnets.
2. Materials: Brass, stainless steel, PVC, or CPCV, as recommended by manufacturer for designated service, unless otherwise shown on the Drawings.
3. Manufacturers and Products:
 - a. Whitey; Catalog No. RF or No. RS.
 - b. Hoke; 3100 through 3300 Series.

G. Valve, Three-Way:

1. Type: Ball valve.
2. Materials: Brass or stainless steel with nylon handle as recommended by manufacturer for designated service, unless otherwise shown on the Drawings.
3. Manufacturers and Products:
 - a. Whitey; Series 41 through Series 43.
 - b. Hoke; Selecto-Mite Series.

H. Valve, Four-Way:

1. Type: Four-way, two-position ball valve.
2. Materials:
 - a. Body and Stem: Type 316 stainless steel.
 - b. Handle: Black nylon.
 - c. Packing Gland: Teflon.
3. Ball and stem bed, one-piece assembly.
4. Machined handle stops and directional nameplates.
5. Manufacturers and Products:
 - a. Whitey; Series 457.
 - b. Hoke; Multi-Mite Series.

I. Spool Valve:

1. Type: Five-port arrangement as shown, two-position, push-to-operate knob attached to the spool stem, and spring return.
2. Materials: Aluminum construction with Teflon impregnated aluminum spool, stainless steel spring, and Buna-N O-rings.
3. Port Connection: 1/4-inch outside diameter tube fittings.
4. Manufacturer and Product: Norgren; T71DAOO-TSO-TKO.

J. Solenoid Valve, Two-Way:

1. Type: Globe valve directly actuated by solenoid and not requiring minimum pressure differential for operation.
2. Materials:
 - a. Body: Brass or stainless steel globe valves as recommended by manufacturer for designated service, unless otherwise shown on the Drawings.
 - b. Valve Seat: Buna-N.
3. Size: Normally closed or opened, as noted.
4. Coil: 115V ac, unless noted otherwise.
5. Solenoid Enclosure: NEMA 4.
6. Manufacturer and Product: ASCO; Red Hat Series 8260.

K. Pressure Regulator, Air:

1. Provide air at reduced pressures, as shown, constant to within plus or minus 10 percent for flows from 0 scfh to 300 scfh with 100 psi supply pressure.
2. Setscrew for outlet pressure adjustment.
3. Integral filter and relief valve.
4. Manufacturers and Products:
 - a. Masoneilan; Series 77-4.
 - b. Fisher; Series 67FR.

L. Pressure Regulator, Water:

1. Materials:
 - a. Body: Bronze.
 - b. Spring Case: Cast iron.
 - c. Seat Rings: Brass.
 - d. Valve Disk and Holder: Buna-N and bronze.
 - e. Diaphragm: Buna-N diaphragm.
2. Sizing: For maximum of 7 psi offset pressure.
3. Manufacturers and Products:
 - a. Fisher; Controls Type 95H or 95L.
 - b. Masoneilan; Series 17.

GRFF OZONE SYSTEM REPLACEMENT

M. Test Tap:

1. Manufacturers and Products:
 - a. Imperial-Eastman; quick-disconnect couplings No. 292-P and caps No. 259-P.
 - b. Crawford Fitting Co.; Swagelok quick-connects Series QC4 and caps QC4-DC.
 - c. Parker; CPI Series precision quick couplings.

N. Copper Tubing and Fittings:

1. Type K hard copper, ASTM B88, with commercially pure wrought copper solder joint fittings. Make joints with 95-5 wire solder, ASTM B32, Grade 95 TA. Do not use cored solder.
2. Alternatively, Type K, soft temper copper tubing, ASTM B88, with brass compression type fittings may be used where shown on the Drawings.
3. Manufacturers:
 - a. Parker-Hannifin.
 - b. Swagelok tube fittings.

O. Plastic Tubing and Fittings:

1. Tubing:
 - a. Polyethylene capable of withstanding 190 psig at 175 degrees F.
 - b. Manufacturers and Products:
 - 1) Dekoron; Type P.
 - 2) Imperial Eastman; Poly-Flo black instrument tubing.
2. Fittings:
 - a. Type: Brass compression.
 - b. Manufacturers and Products:
 - 1) Imperial Eastman; Poly-Flo tube fittings.
 - 2) Dekoron; E-Z fittings.

P. Stainless Steel Tubing: ASTM A312/A312M, Type 316, 0.065-inch wall, seamless, soft annealed, as shown on the Drawings.

Q. Stainless Steel Fittings:

1. Compression Type:
 - a. Materials: Type 316 stainless steel, ASTM A182/A182M forged bodies or ASTM A276 barstock bodies, flareless.

- b. Manufacturers and Products:
 - 1) Parker Flodar; BA Series.
 - 2) Swagelok tube fittings.
 - 3) Parker CPI tube fittings; Parker A-LOK dual ferrule tube fittings.
 - 2. Socket Weld Type:
 - a. Materials: Type 316 stainless steel, ASTM A182/A182M forged bodies or ASTM A276 barstock bodies, 3,000 psi maximum working pressure, safety factor 4:1.
 - b. Manufacturers:
 - 1) Cajon.
 - 2) Swagelok.
 - 3) Parker WELDLOK.
- R. Air Set: Consists of a shutoff valve, pressure regulator, discharge pressure gauge, and interconnecting tubing.
- S. Purge Set:
 - 1. Parts: Purge rotameter flow element, pressure regulator, pressure gauge, test tap, shutoff valve, spool valve, and interconnecting tubing as shown on the Drawings and as required in this section.
 - 2. Pressure Gauge Scale Range: 150 percent of the process variable.
 - 3. Mounting:
 - a. Within consoles, panels, or a separate enclosure as shown.
 - b. For separate enclosure mounted purge sets, refer to paragraphs Nonfreestanding Panel Construction and Factory Finishing for enclosure requirements.
- T. Tubing Raceways:
 - 1. Cable tray systems complete with tees, elbows, reducers, and covers.
 - 2. Size in accordance with manufacturer's recommendations for intended service.
 - 3. Materials: Galvanized steel or aluminum brass as recommended by manufacturer for designated service, unless otherwise shown on the Drawings.
 - 4. Manufacturers:
 - a. Globetrax.
 - b. Cope.

GRFF OZONE SYSTEM REPLACEMENT

U. Air Supply Sets:

1. Parts:
 - a. Integrally Mounted:
 - 1) Pressure Controls: Automatic START/STOP, factory set at 30 psig to 50 psig.
 - 2) Valves: Manual drain, manual shutoff, pressure relief, and check valve.
 - 3) Pressure gauge.
 - 4) Inlet filter muffler.
 - 5) Power: 120V ac.
 - 6) Compressor: Oilless, single cylinder, rated for at least 1 scfm at 50 psig.
 - 7) Manufacturers and Product:
 - a) ITT Pneumotive; GH Series.
 - b) Gast.
 2. Simplex Air Supply Sets:
 - a. Air Receiver: 2 gallons.
 - b. Compressors: One.
 3. Duplex Air Supply Sets:
 - a. Air Receiver: 20 gallons.
 - b. Compressors: Two.
 - c. Automatic Failover Control: Factory set at 20 psig.

2.03 ELECTRICAL COMPONENTS

A. Terminal Blocks for Enclosures:

1. General:
 - a. Connection Type: Screw compression clamp.
 - b. Compression Clamp:
 - 1) Complies with DIN-VDE 0611.
 - 2) Hardened steel clamp with transversal grooves that penetrate wire strands providing a vibration-proof connection.
 - 3) Guides strands of wire into terminal.
 - c. Screws: Hardened steel, captive, and self-locking.
 - d. Current Bar: Copper or treated brass.
 - e. Insulation:
 - 1) Thermoplastic rated for minus 55 degrees C to plus 110 degrees C.
 - 2) Two funneled shaped inputs to facilitate wire entry.

GRFF OZONE SYSTEM REPLACEMENT

- f. Mounting:
 - 1) Standard DIN rail.
 - 2) Terminal block can be extracted from an assembly without displacing adjacent blocks.
 - 3) End Stops: Minimum of one at each end of rail.
- g. Wire Preparation: Stripping only permitted.
- h. Jumpers: Allow jumper installation without loss of space on terminal or rail.
- i. Marking System:
 - 1) Terminal number shown on both sides of terminal block.
 - 2) Allow use of preprinted and field marked tags.
 - 3) Terminal strip numbers shown on end stops.
 - 4) Mark terminal block and terminal strip numbers as shown on panel control diagrams and loop diagrams.
 - 5) Fuse Marking for Fused Terminal Blocks: Fuse voltage and amperage rating shown on top of terminal block.
- j. Test Plugs: Soldered connections for 18 AWG wire.
 - 1) Pin Diameter: 0.079 inch.
 - 2) Quantity: Two plugs per test meter.
 - 3) Manufacturer: Siemens or Phoenix Contact.
- 2. Terminal Block, General Purpose:
 - a. Rated Voltage: 600V ac.
 - b. Rated Current: 30 amp.
 - c. Wire Size: 24 AWG to 10 AWG.
 - d. Rated Wire Size: 10 AWG.
 - e. Color: Gray body.
 - f. Spacing: 0.25 inch, maximum.
 - g. Test Sockets: One screw test socket 0.079-inch diameter.
 - h. Manufacturer: Siemens or Phoenix Contact.
- 3. Terminal Block, Ground:
 - a. Wire Size: 24 AWG to 10 AWG.
 - b. Rated Wire Size: 10 AWG.
 - c. Color: Green and yellow body.
 - d. Spacing: 0.25 inch, maximum.
 - e. Grounding: Electrically grounded to mounting rail.
 - f. Manufacturer: Siemens or Phoenix Contact.
- 4. Terminal Block, Blade Disconnect Switch:
 - a. Rated Voltage: 600V ac.
 - b. Rated Current: 10 amp.
 - c. Wire Size: 22 AWG to 10 AWG.
 - d. Rated Wire Size: 10 AWG.
 - e. Color: Gray body, orange switch.
 - f. Spacing: 0.25 inch, maximum.
 - g. Manufacturer: Siemens or Phoenix Contact.

GRFF OZONE SYSTEM REPLACEMENT

5. Terminal Block Diode:
 - a. Rated Voltage: 24V dc.
 - b. Rated Current: 30 mA.
 - c. Wire Size: 16 AWG.
 - d. Manufacturer and Product: Phoenix Contact; ST-IN.
6. Terminal Block, Fused, 24V dc:
 - a. Rated Voltage: 600V dc.
 - b. Rated Current: 25 amp.
 - c. Wire Size: 22 AWG to 10 AWG.
 - d. Rated Wire Size: 10 AWG.
 - e. Color: Gray body.
 - f. Fuse: 0.25 inch by 1.25 inches.
 - g. Indication: LED diode 24V dc.
 - h. Spacing: 0.512 inch, maximum.
 - i. Manufacturer: Siemens or Phoenix Contact.
7. Terminal Block, Fused, 120V ac:
 - a. Rated Voltage: 600V ac.
 - b. Rated Current: 25 amp.
 - c. Wire Size: 22 AWG to 10 AWG.
 - d. Rated Wire Size: 10 AWG.
 - e. Color: Gray body.
 - f. Fuse: 0.25 inch by 1.25 inches.
 - g. Indication: Neon lamp, 110V ac.
 - h. Leakage Current: 1.8 mA, maximum.
 - i. Spacing: 0.512 inch, maximum.
 - j. Manufacturer: Siemens or Phoenix Contact.
8. Terminal Block, Fused, 120V ac, High Current:
 - a. Rated Voltage: 600V ac.
 - b. Rated Current: 35 amps.
 - c. Wire Size: 18 AWG to 8 AWG.
 - d. Rated Wire Size: 8 AWG.
 - e. Color: Gray.
 - f. Fuse: 13/32 inch by 1.5 inches.
 - g. Spacing: 0.95 inch, maximum.
 - h. Manufacturer: Siemens or Phoenix Contact.

B. Relays:

1. General:
 - a. Relay Mounting: Plug-in type socket.
 - b. Relay Enclosure: Furnish dust cover.
 - c. Socket Type: Screw terminal interface with wiring.
 - d. Socket Mounting: Rail.
 - e. Provide holddown clips.

GRFF OZONE SYSTEM REPLACEMENT

2. Signal Switching Relay:
 - a. Type: Dry circuit.
 - b. Contact Arrangement: 2 Form C contacts.
 - c. Contact Rating: 5 amps at 28V dc or 120V ac.
 - d. Contact Material: Gold or silver.
 - e. Coil Voltage: As noted or shown.
 - f. Coil Power: 0.9 watt (dc), 1.2VA (ac).
 - g. Expected Mechanical Life: 10,000,000 operations.
 - h. Expected Electrical Life at Rated Load: 100,000 operations.
 - i. Indication Type: Neon or LED indicator lamp.
 - j. Seal Type: Hermetically sealed case.
 - k. Manufacturer: Siemens.
3. Control Circuit Switching Relay, Nonlatching:
 - a. Type: Compact general purpose plug-in.
 - b. Contact Arrangement: 3 Form C contacts.
 - c. Contact Rating: 10A at 28V dc or 120V ac, and 6.6A at 240V ac.
 - d. Contact Material: Silver cadmium oxide alloy.
 - e. Coil Voltage: As noted or shown.
 - f. Coil Power: 1.8 watts (dc), 2.7VA (ac).
 - g. Expected Mechanical Life: 10,000,000 operations.
 - h. Expected Electrical Life at Rated Load: 100,000 operations.
 - i. Indication Type: Neon or LED indicator lamp.
 - j. Push-to-test button.
 - k. Manufacturer: Siemens.
4. Control Circuit Switching Relay, Latching:
 - a. Type: Dual coil mechanical latching relay.
 - b. Contact Arrangement: 2 Form C contacts.
 - c. Contact Rating: 10A at 28V dc or 120V ac.
 - d. Contact Material: Silver cadmium oxide alloy.
 - e. Coil Voltage: As noted or shown.
 - f. Coil Power: 2.7 watts (dc), 5.3VA (ac).
 - g. Expected Mechanical Life: 500,000 operations.
 - h. Expected Electrical Life at Rated Load: 50,000 operations.
 - i. Manufacturer: Siemens.
5. Control Circuit Switching Relay, Time Delay:
 - a. Type: Adjustable time delay relay.
 - b. Contact Arrangement: 2 Form C contacts.
 - c. Contact Rating: 10A at 30V dc or 277V ac.
 - d. Contact Material: Silver cadmium oxide alloy.
 - e. Coil Voltage: As noted or shown.
 - f. Operating Temperature: Minus 10 degrees C to 55 degrees C.
 - g. Repeatability: Plus or minus 2 percent.
 - h. Delay Time Range: Select range such that time delay setpoint fall between 20 percent to 80 percent of range.
 - i. Time Delay Setpoint: As noted or shown.

GRFF OZONE SYSTEM REPLACEMENT

- j. Mode of Operation: As noted or shown.
- k. Adjustment Type: Integral potentiometer with knob external to dust cover.
- l. Manufacturer: Siemens.

C. Surge Suppressors:

- 1. General:
 - a. Construction: First-stage, high-energy metal oxide varistor and second-stage, bipolar silicon avalanche device separated by series impedance; includes grounding wire, stud, or terminal.
 - b. Response: 5 nanoseconds maximum.
 - c. Recovery: Automatic.
 - d. Temperature Range: Minus 20 degrees C to plus 85 degrees C.
 - e. Enclosure Mounted: Encapsulated inflame retardant epoxy.
- 2. Suppressors on 120V ac Power Supply Connections:
 - a. Occurrences: Tested and rated for a minimum of 50 occurrences of IEEE C62.41 Category B test waveform.
 - b. First-Stage Clamping Voltage: 350 volts or less.
 - c. Second-Stage Clamping Voltage: 210 volts or less.
 - d. Power Supplies for Continuous Operation:
 - 1) Four-Wire Transmitter or Receiver: Minimum 5 amps at 130V ac.
 - 2) All Other Applications: Minimum 30 amps at 130V ac.
- 3. Suppressors on Analog Signal Lines:
 - a. Test Waveform: Linear 8-microsecond rise in current from 0 amps to a peak current value followed by an exponential decay of current reaching one-half the peak value in 20 microseconds.
 - b. Surge Rating: Tested and rated for 50 occurrences of 2,000-amp peak test waveform.
 - 1) dc Clamping Voltage: 20 percent to 40 percent above operating voltage for circuit.
 - 2) dc Clamping Voltage Tolerance: Plus or minus 10 percent.
 - 3) Maximum Loop Resistance: 18 ohms per conductor.
- 4. Manufacturers and Products:
 - a. Analog Signals Lines: Siemens.
 - b. 120V ac Lines: Siemens.
 - c. Field Mounted at Two-Wire Instruments: Encapsulated in stainless steel pipe nipples.

- d. Field Mounted at Four-Wire Instruments: With 120V ac outlet, ac circuit breaker, and 10-ohm resistors on signal lines, all in enclosure.
 - 1) Enclosure:
 - a) NEMA 4X, Type 316 stainless steel with door.
 - b) Maximum Size: 12 inches by 12 inches by 8 inches deep.

D. Power Supplies:

- 1. Furnish as required to power instruments requiring external dc power, including two-wire transmitters and dc relays. Provide dual power supplies with diode auctioneered outputs.
- 2. Convert 120V ac, 60-Hz power to dc power of appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.
- 3. Provide output over voltage and over current protective devices to:
 - a. Protect instruments from damage due to power supply failure.
 - b. Protect power supply from damage due to external failure.
- 4. Enclosures: NEMA 1.
- 5. Mount such that dissipated heat does not adversely affect other components.
- 6. Fuses: For each dc supply line to each individual two-wire transmitter.
 - a. Type: Indicating.
 - b. Mount so fuses can be easily seen and replaced.

2.04 I&C COMPONENTS

A. A29 Ambient Oxygen Gas Analyzer:

- 1. The oxygen gas detection system shall measure and display ambient oxygen gas concentration. Provide relay output for alarms.
- 2. Provide a system consisting of a monitor/readout unit and oxygen gas sensor units. House the monitor/readout unit in a NEMA 4X enclosure, suitable for wall mounting. Provide access to the inside of the enclosure, monitor front panel and wiring connections through a hinged, front facing, full length door. Supply the door with a shatterproof window of sufficient size to allow the viewing of all meters and alarm indicating lights. Provide wiring access into the enclosure via a removable entry plate on the bottom surface of the enclosure.
- 3. Provide a range of 0 percent to 25 percent oxygen concentration by volume for the monitor/readout unit.
- 4. Provide a three-digit LED display for the purpose of displaying the value of each sensor. Configure the readout to read any value between 0.0 and 99.0 and display units in percent.

GRFF OZONE SYSTEM REPLACEMENT

5. Supply the monitor with a separate indicating light for caution, warning, and alarm for each oxygen sensor.
6. Provide two separate alarm set point levels for each sensor.
7. Provide a minimum of two relays for each set point level. Provide all relays with time delays adjustable from 0 minute to 15 minutes to prevent chatter and control oscillation. Provide form C relays, SPDT rated for 5 Amp resistive at 120V ac.
8. The system shall operate on 120V ac, 60 Hz.
9. Provide an oxygen sensor of the electrochemical fuel cell-type, not requiring the periodic addition of reagents and having a useful life for a minimum of 1 year.
10. No periodic maintenance other than periodic checking of sensor unit function shall be required. Periodic sensor checking or actual adjustment of the sensor units shall be accomplished by one person at the sensor unit location.
11. Manufacturer and Product: ULTIMA XE, Teledyne Analytical; Model 3350, "or-equal."

B. A40 Dissolved Ozone Analyzers:

1. Dissolved ozone analyzer/transmitter shall be capable of the accurate measurement of ozone-in-water in the range 0.0 mg/L to 10.0 mg/L, with an accuracy of plus or minus 1 percent signal and sensor signal drift of less than 0.5 percent per month. Each unit shall include a built-in LCD display with a minimum of 2 cm high characters. Use solid state electronics; supply all boards of the plug-in-type to allow for easy replacement.
2. The analyzer/transmitter shall be housed in a NEMA 4 enclosure. Provide access to the inside of the enclosure, monitor front panel and wiring connections through a hinged, front facing, full length door. Supply the door with a shatterproof window of sufficient size to allow the viewing of all meters and alarm indicating lights. Provide wiring access into the enclosure via a removable entry plate on the bottom surface of the enclosure.
3. The unit shall operate on 120V ac, 60 Hz power; provide an internal battery to maintain unit calibration in case of power failure. Provide the unit with an isolated 4 mA to 20 mA output signal capable of driving loads up to 500 ohms, and dual Form C alarm relay contacts rated for 2A at 125V ac. The unit shall be capable of operating in an ambient environment of 2 degrees C to 35 degrees C with 95 percent relative humidity noncondensing and at a sample water pressure of up to 20 psig.

GRFF OZONE SYSTEM REPLACEMENT

4. The ozone-in-water sensor shall be of the electrochemical cell type. As ozone diffuses through the membrane, electrochemical reactions shall take place at the cathode and anode in the presence of the electrolyte. The resulting current flow shall be proportional to the amount of ozone diffusing through the membrane.
5. Supply a recharge kit for the sensors.
6. Furnish the sensors with an in-pipe flow chamber and appurtenances, as required, to provide a sensor mounting point in the ozonated water sample flow stream.
7. Acceptable Manufactures: Rosemount.
 - a. Transmitter: Model 1058.
 - 1) Include the required stainless steel mounting bracket for wall mount applications.
 - b. Probe: Model 499AOZ-54-VP.
 - c. VP Cable: Interconnecting variopol cable for 499 ACL sensor. 4 feet long. Part No. 23727-04.
 - d. Flow Thru Tee:
 - 1) For 3/4 inch process lines, Part No. 915240-03.
 - 2) For 1 inch process lines, Part No. 915240-04.
 - e. Probe Maintenance Kit:
 - 1) Amperometric fill solution No. 3 (for Ozone probes), Part No. 9210299
 - 2) Membrane Assembly for Ozone probes, Part No. 23502-11.
8. Provide the quantity required for a 2-year supply from time of shipment, assuming maintenance every 3-months.

C. A44 Ozone Analyzer (Low Concentration) for Ambient Ozone Analysis:

1. Provide an ozone analyzer of the low concentration, ultraviolet absorption ozone photometer-type capable of measuring ozone concentration in air and oxygen between 0 and 1 parts per million by volume with repeatability of 1 percent or two digits, whichever is greater. The analyzer shall have an accuracy of 3 percent or greater and a normal cycle time interval of 20 seconds or less. The sample gas flow rate shall be a nominal 1 liter per minute. The analyzer output signal drift shall be less than 0.5 percent per day and less than 1 percent per week.
2. The analyzer shall be equipped with a microprocessor that performs the ozone analysis based on the Beer-Lambert law.
3. The analyzer shall include temperature and pressure compensation.
4. The analyzer shall be housed in a NEMA 4X wall-mount enclosure. Provide access to the inside of the enclosure, monitor front panel and wiring connections through a hinged, front facing, full length door. Supply the door with a shatterproof window of sufficient size to allow the viewing of all meters and alarm indicating lights. Provide wiring

GRFF OZONE SYSTEM REPLACEMENT

access into the enclosure via a removable entry plate on the bottom surface of the enclosure.

5. The analyzer shall be capable of displaying and transmitting an output signal in multiple ranges over the ozone measurement range.
6. Each analyzer shall include an integral sampling pump where required for the installation.
7. The analyzer shall operate on 120V ac plus or minus 10 percent, 60 Hz. The unit shall have an isolated 4 mA dc to 20 mA dc output capable of driving loads up to 500 ohms. The unit shall have a built in indicator to display ozone concentration.
8. Provide two DPDT alarm relays for remote indication that can activate at individually adjustable set points of measured ozone level. The system shall provide visual alarms when preset limits are exceeded.
9. Furnish the analyzers with integrally mounted sampling pump, pressure regulating valves, rotameters, flow regulating valves, and appurtenances, as required to provide and maintain the sample volume within the analyzer manufacturer's guidelines.
10. Manufacturers and Products:
 - a. Teledyne API; Model 465L.
 - b. PCI Ozone; 500 Series LC.
 - c. "Or-equal."

D. F4 Flow Element and Transmitter, Electromagnetic:

1. General:
 - a. Function: Measure, indicate, and transmit the flow of a conductive process liquid in a full pipe.
 - b. Type:
 - 1) Electromagnetic flowmeter, with operation based on Faraday's Law, utilizing the pulsed dc type coil excitation principle with high impedance electrodes.
 - 2) Full bore meter with magnetic field traversing entire flow-tube cross-section.
 - c. Parts: Flow element, transmitter, interconnecting cables, and mounting hardware. Other parts as noted.
2. Service:
 - a. Stream Fluid:
 - 1) As noted.
 - 2) Suitable for liquids with a minimum conductivity of 5 microS/cm and for demineralized water with a minimum conductivity of 20 microS/cm.
 - b. Flow Stream Descriptions: If and as described below.
 - 1) Cooling water.
 - 2) Dilution water.
 - 3) Sodium bisulfite, concentrated.

3. Operating Temperature:
 - a. Element:
 - 1) Ambient: Minus 5 degrees F to 140 degrees F, typical, unless otherwise noted.
 - 2) Process: Minus 5 degrees F to 140 degrees F, typical, unless otherwise noted.
 - b. Transmitter:
 - 1) Ambient: Minus 5 degrees F to 140 degrees F, typical, unless otherwise noted.
 - 2) Storage: 15 degrees F to 120 degrees F, typical, unless otherwise noted.
4. Performance:
 - a. Flow Range: As noted.
 - b. Accuracy: Plus or minus 0.5 percent of rate for all flows resulting from pipe velocities of 2 feet to 30 feet per second.
 - c. Turndown Ratio: Minimum of 10 to 1 when flow velocity at minimum flow is at least 1 foot per second.
5. Features:
 - a. Zero stability feature to eliminate the need to stop flow to check zero alignment.
 - b. No obstructions to flow.
 - c. Very low pressure loss.
6. Process Connection:
 - a. Meter Size (diameter inches): As noted.
 - b. Connection Type: 150-pound ANSI raised-face flanges; AWWA C207, Table 2, Class D; or wafer style depending on meter size, unless otherwise noted.
 - c. Flange Material: Carbon steel, unless otherwise noted.
7. Power (Transmitter): 120V ac, 60-Hz, unless otherwise noted.
8. Element:
 - a. Meter Tube Material: Type 304 or Type 316 stainless steel, unless otherwise noted.
 - b. Liner Material: Teflon, unless otherwise noted.
 - c. Liner Protectors: Covers (or grounding rings) on each end to protect liner during shipment.
 - d. Electrode Type: Flush or bullet nose as recommended by the manufacturer for the noted stream fluid.
 - e. Electrode Material: Type 316 stainless steel or Hastelloy C, unless otherwise noted.
 - f. Grounding Ring:
 - 1) Required, unless otherwise noted.
 - 2) Quantity: Two, unless otherwise noted.
 - 3) Material: Type 316 stainless steel, unless otherwise noted.
 - g. Enclosure: NEMA 4X, minimum, unless otherwise noted.

GRFF OZONE SYSTEM REPLACEMENT

- h. Hazardous Area Certification:
 - 1) Class 1, Division 2, Groups A, B, C, D: If noted.
 - 2) Class 1, Division 1, Groups A, B, C, D, and FM approved: If noted.
 - 3) Class 1, Division 1, Groups C, D, and FM approved: If noted.
- 9. Transmitter:
 - a. Mounting: Surface (wall), unless otherwise noted.
 - b. Display: Required, unless otherwise noted.
 - 1) Digital LCD display, indicating flow rate and total.
 - c. Parameter Adjustments: By keypad or non-intrusive means.
 - d. Enclosure: NEMA 4X, minimum, unless otherwise noted.
 - e. Empty Pipe Detection:
 - 1) If noted.
 - 2) Drives display and outputs to zero when empty pipe detected.
- 10. Signal Interface (at Transmitter):
 - a. Analog Output:
 - 1) Isolated 4 mA dc to 20 mA dc for load impedance from 0 ohm to at least 500 ohms minimum for 24V dc supply.
 - 2) Supports Superimposed Digital HART protocol: If noted.
 - b. Profibus Communication: FIT-26241 and FIT-26242 shall be furnished with Profibus interface with cable entry compatible with the existing Profibus cable size.
- 11. Cables:
 - a. Types: As recommended by manufacturer.
 - b. Lengths: As required to accommodate device locations.
- 12. Built-in Diagnostic System:
 - a. Features:
 - 1) Field programmable electronics.
 - 2) Self-diagnostics with troubleshooting codes.
 - 3) Ability to program electronics with full scale flow, engineering units, meter size, zero flow cutoff, desired signal damping, totalizer unit digit value, etc.
 - 4) Initial flow tube calibration and subsequent calibration checks.
- 13. Factory Calibration:
 - a. Calibrated in an ISO 9001 and NIST certified factory.
 - b. Factory flow calibration system must be certified by volume or weight certified calibration devices.
 - c. Factory flow calibration system shall be able to maintain calibration flow rate for at least 5 minutes for repeatability point checks.

GRFF OZONE SYSTEM REPLACEMENT

14. Factory Ready for Future In situ Verifications: If noted.
 - a. Original meter parameter values available from vendor by request.
 15. Accessories:
 - a. In situ Verification System: If noted.
 - 1) Quantity: One complete system provided for the Project.
 - 2) Verifies quantitatively that the meter and signal converter's present condition is the same as originally manufactured.
 - 3) Physical access to the flow-tube not required.
 - 4) Meet standards established by the National Testing Laboratory.
 - 5) Tests and stores over 50-meter parameters related to primary coils, electrodes, interconnecting cable, and signal converter.
 - 6) Verification standard shall be plus or minus 1 percent of wet calibration for meters produced using the calibration verification service, or plus or minus 2 percent for standard meters.
 - 7) Windows-based software.
 - b. Primary Simulation System: If noted.
 - 1) Quantity: One complete system provided for the project.
 - 2) Verifies proper operation of the signal converter by simulating the flow meter's output signal.
 - a) Generates pulsed dc excitation signal with a reference voltage of 70 mV.
 - b) Generated signal ranges from 0 percent to 99 percent (0 feet to 32.8 feet per second) with a resolution of 0.1 percent.
 - c) Switch selectable for forward, reverse and zero flow rate.
 - 3) Verifies various input and output signals.
 16. Manufacturer and Product:
 - a. Endress + Hauser, Inc. Flow Measuring System: Promag 500 series "or-equal."
- E. F5 Flow Element and Transmitter, Compact Electromagnetic:
1. General:
 - a. Function: Measure, indicate, and transmit the flow of sample ozone residual water.
 - b. Type:
 - 1) Electromagnetic flowmeter, with operation based on Faraday's Law, utilizing the pulsed dc type coil excitation principle with high impedance electrodes.
 - 2) Small form factor, integrated design.

GRFF OZONE SYSTEM REPLACEMENT

2. Service:
 - a. Stream Fluid:
 - 1) Water, ozone residual sample.
 - 2) Suitable for a minimum conductivity of 20 microS/cm.
3. Operating Temperature:
 - a. Ambient: 14 degrees F to 140 degrees F.
 - b. Process: 15 degrees F to 158 degrees F.
4. Performance:
 - a. Flow Range: 0 gpm to 4 gpm.
 - b. Accuracy: Plus or minus 0.5 percent of the full scale.
5. Features:
 - a. Zero stability feature to eliminate the need to stop flow to check zero alignment.
 - b. No obstructions to flow.
 - c. Very low pressure loss.
6. Process Connection: 1/2 inches NPT.
7. Power : 24V dc.
8. Element:
 - a. Material: Type 316 stainless steel, unless otherwise noted.
 - b. Liner Material: PEEK.
 - c. Liner Protectors: Covers (or grounding rings) on each end to protect liner during shipment.
 - d. Electrode Type: Flush.
 - e. Electrode Material: Type 316 stainless steel.
 - f. Grounding Ring: Not required.
9. Transmitter:
 - a. Integrated with the Element.
 - b. Display: Required.
 - 1) Digital LCD display, indicating flow rate and total.
 - c. Parameter Adjustments: Bluetooth or IO-Link interface.
 - d. Enclosure: IP65/67.
 - e. Empty Pipe Detection: Drives display and outputs to zero when empty pipe detected.
10. Signal Interface:
 - a. Analog Output: Isolated 4 mA dc to 20 mA dc for load impedance from 0 ohm to at least 500 ohms minimum for 24V dc supply.
11. Cables:
 - a. Types: As recommended by manufacturer.
 - b. Lengths: As required to accommodate device locations.
12. Built-in Diagnostic System:
 - a. Features:
 - 1) Field programmable electronics.
 - 2) Self-diagnostics with troubleshooting codes.

- 3) Ability to program electronics with full scale flow, engineering units, meter size, zero flow cutoff, desired signal damping, totalizer unit digit value, etc.
- 4) Initial flow tube calibration and subsequent calibration checks.
13. Factory Calibration:
 - a. Calibrated in an ISO 9001 and NIST certified factory.
 - b. Factory flow calibration system must be certified by volume or weight certified calibration devices.
 - c. Factory flow calibration system shall be able to maintain calibration flow rate for at least 5 minutes for repeatability point checks.
14. Factory Ready for Future In situ Verifications: If noted.
 - a. Original meter parameter values available from vendor by request.
15. Manufacturers and Products:
 - a. Endress + Hauser, Inc.: Picomag IO-link.
 - b. "Or-equal."
- F. F6 Flow Element and Transmitter, Electromagnetic for Chemical Applications:
 1. General:
 - a. Function: Measure, indicate, and transmit the flow of chemical liquids in a full pipe.
 - b. Type: Electromagnetic flowmeter, with operation based on Faraday's Law, utilizing the pulsed dc type coil excitation principle with high impedance electrodes.
 - c. Components: Flow element, transmitter, mounting hardware.
 2. Service:
 - a. Stream Fluid: Sodium Bisulfite.
 3. Operating Temperature:
 - a. Ambient: 14 degrees F to 140 degrees F.
 - b. Process: 15 degrees F to 158 degrees F.
 4. Performance:
 - a. Flow Velocity: 1 foot to 30 feet per second.
 - b. Accuracy: Plus or minus 0.5 percent of rate for pipe velocities of 1 foot to 30 feet per second.
 5. Features:
 - a. Bi-directional flow measurement.
 - b. No obstructions to flow.
 - c. Very low pressure loss.
 6. Process Connection: 1/2 inches NPT.
 7. Power : 24V dc.

GRFF OZONE SYSTEM REPLACEMENT

8. Element:
 - a. Material: Type 304 stainless steel, unless otherwise noted.
 - b. Liner Material: Ceramic.
 - c. Electrode Material: Hastelloy.
 - d. Grounding Ring: external grounding ring.
9. Transmitter:
 - a. Mounting: integral to meter, ability for remote mount without modification to transmitter unit.
 - b. Display: Required.
 - 1) Digital LCD display, indicating flow rate and total.
 - c. Parameter Adjustments: keypad.
 - d. Enclosure: IP65/67.
 - e. Empty Pipe Detection: Drives display and outputs to zero when empty pipe detected.
10. Signal Interface:
 - a. Analog Output: Isolated 4 mA dc to 20 mA dc for load impedance from 0 ohm to at least 500 ohms minimum for 24V dc supply.
11. Cables:
 - a. Types: As recommended by manufacturer.
 - b. Lengths: As required to accommodate device locations.
12. Built-in Diagnostic System:
 - a. Features:
 - 1) Field programmable electronics.
 - 2) Self-diagnostics with troubleshooting codes.
 - 3) Ability to program electronics with full scale flow, engineering units, meter size, zero flow cutoff, desired signal damping, totalizer unit digit value, etc.
13. Factory Calibration:
 - a. Calibrated in an ISO 9001 and NIST certified factory.
 - b. Factory flow calibration system must be certified by volume or weight certified calibration devices.
 - c. Factory flow calibration system shall be able to maintain calibration flow rate for at least 5 minutes for repeatability point checks.
14. Manufacturers and Products:
 - a. Meter Tube: Siemens Mag1100 or FMS100, without exception.
 - b. Transmitter: Siemens Mag6000 or FMT-020, without exception.
 - c. Communications Card: Profibus DP (1 for each meter).
 - d. Required Siemens Accessories:
 - 1) Wall Mount Kit (transmitter head planned for remote mounting).
 - 2) Remote Cabling (only for remote mount applications).
 - 3) Grounding Ring (1 per meter).
 - 4) Threaded Adapters (1/2 inch NPT) for process pipe connection.

15. Special Requirements for Startup and Commissioning:
 - a. Supplier is required to configure the ProfibusDP communication card for network communication. Supplier is to set the ProfibusDP Slave Address. Address will be supplied by the PIC Integrator.
 - b. Supplies must be onsite during the flow meter hardware transition to support the hardware configuration while the associated PLC hardware is also updated by the PIC Integrator to accommodate the changes in the network hardware configuration. Plan for 1-day of onsite support time specifically for both mag meters.
- G. F18 Flow Element and Switch, Paddle Bellows:
1. General:
 - a. Function: Monitor process fluid flow and provide contact closure at setpoint.
 - b. Type: According to the diaphragm plate principle. Baffle/paddle is deflected in the flow direction against the force of the spring by the flowing medium.
 2. Service:
 - a. Process Fluid: Water.
 - b. Process Pressure: As noted.
 - c. Process Temperature: As noted.
 3. Performance:
 - a. Setpoint: As noted.
 - 1) Factory Calibration: If noted.
 - b. Accuracy: Plus or minus 2 percent of reading.
 4. Features:
 - a. Wetted Surfaces Materials: Type 316 stainless steel, unless otherwise noted.
 - b. Temperature Compensation: Via factory calibration.
 5. Process Connections: Weld-on flange.
 6. Conduit Connection: As noted.
 7. Element Insertion Length: As noted.
 8. Electronics:
 - a. Location: Integral.
 - b. Operating Temperature: Minus 40 degrees F to 140 degrees F.
 - c. Calibration Circuit: Built in for field adjustment of setpoint.
 9. Signal Interface Contact: Field selectable two SPDT or one DPDT, rated 6 amps at 115V ac, 220V ac or 24V dc. SPDT with separate setpoints.
 10. Enclosure:
 - a. Type: NEMA 4X.
 - b. Enclosure: Aluminum, unless otherwise noted.

GRFF OZONE SYSTEM REPLACEMENT

11. Ancillaries:
 - a. Furnish interconnecting cable if remote electronics specified.
 - 1) Cable Jacket: PVC, unless otherwise noted.
 - 2) Cable Length: 10 feet, unless otherwise noted.
12. Power: 120V ac, 60-Hz, unless otherwise noted.
13. Identifying Tag: Stainless steel.
14. Manufacturer and Product: KOBOLD; DWU, "or-equal."

H. L2 Level Element and Switch, Electrode:

1. General:
 - a. Function: Activate contact at preset liquid level.
 - b. Type: Capacitance; dry relays.
 - c. Parts: Electrode, relay, enclosure, cabling.
2. Performance:
 - a. Setpoint: As noted.
 - b. Accuracy: Plus or minus 1/16-inch electrode tip length.
 - c. Sensitivity: As required for (conductivity of) specific liquid application.
3. Service:
 - a. Process Liquid: Water.
 - b. Operating Temperature: As noted.
 - c. Operating Pressure: As noted.
4. Electrode Holder:
 - a. Type: External pipe threaded, unless otherwise noted.
 - b. Material: Type 316 stainless steel, unless otherwise noted.
 - c. Mounting: 3/4-inch NPT.
5. Electrodes:
 - a. Type: Probe.
 - b. Length: As required for noted setpoints.
 - c. Material: Type 316 stainless steel electrodes, unless otherwise noted.
6. Relays:
 - a. Type: Dry relay, unless otherwise noted.
 - b. Number: One per noted setpoint.
 - c. Sensitivity: As required for (conductivity of) specific liquid application.
 - d. Power: Suitable for 120V ac 60 Hz.
 - e. Contacts: DPDT, rated at 10 amps continuous at 120V ac.
 - f. Enclosure: NEMA 4X fiberglass, unless otherwise noted.
7. Manufacturer and Product: AMETEK; Z-Tron IV, "or-equal."

I. P2 Pressure Differential Switch:

1. General:
 - a. Function: Monitor differential pressure.
 - b. Type: Diaphragm actuated switch.
2. Performance:
 - a. Setpoint:
 - 1) As noted.
 - 2) Repeatability: Plus or minus 1 percent.
 - b. Range: Noted setpoint shall fall between 20 percent and 90 percent of range.
 - c. Static Pressure:
 - 1) Operating Static Pressure: As noted.
 - 2) Operating static pressure must be less than switch's rated maximum static pressure.
 - d. Overpressure Proof Pressure: At least 400 percent of rated maximum static pressure.
 - e. Operating Temperature Range:
 - 1) Dependent on actuator seal materials.
 - 2) Teflon Seal: 0 degree F to 150 degrees F.
3. Features:
 - a. Actuator Seal: Teflon, unless otherwise noted.
 - b. Fixed differential, unless otherwise noted.
 - c. Mounting: Surface, unless otherwise noted.
4. Process Connection:
 - a. 1/4-inch NPT female connections, unless otherwise noted.
 - b. Materials: Nickel-plated brass, unless otherwise noted.
5. Enclosure: NEMA 4X.
6. Signal Interface:
 - a. Contact Type:
 - 1) SPDT, unless otherwise noted.
 - 2) Rated for 10 amps minimum at 120V ac.
 - b. Hermetically Sealed Switch: If noted.
7. Manufacturers and Products:
 - a. Ashcroft; Type 400, D Series.
 - b. United Electric; 400 Series.
 - c. Or Engineer approved equal.

J. P3 Pressure Differential Transmitter:

1. General:
 - a. Function:
 - 1) Measure differential pressure.
 - 2) Transmit signal proportional to either differential pressure, or level as applicable.

GRFF OZONE SYSTEM REPLACEMENT

- b. Type:
 - 1) Electronic variable capacitance or silicon strain gauge.
 - 2) Two-wire transmitter; “smart electronics.”
- c. Parts: Transmitter and accessories.
- 2. Performance:
 - a. Range: As noted.
 - 1) Select transmitter’s factory upper range limit (URL) such that upper boundary of noted range is as close as possible to 80 percent of factory URL, but does not exceed it.
 - b. Accuracy: Plus or minus 0.10 percent of span, unless otherwise noted.
 - c. Ambient Operating Temperature: Minus 40 degrees F to plus 175 degrees F, with integral meter.
 - d. Process Operating Temperature: Minus 40 degrees F to plus 250 degrees F.
 - e. Humidity: 0 percent to 100 percent relative humidity.
 - f. Hazardous Location Certifications: If and as noted.
- 3. Features:
 - a. Linear or square-root output, user-configurable.
 - b. Adjustable damping.
 - c. LCD indicator, unless otherwise noted: Display in either percent or engineering units, field configurable.
 - d. Wetted Metallic Parts: Type 316 stainless steel, unless otherwise noted.
 - 1) Includes drain/vent valves; process flanges and adapters, and process isolating diaphragm.
 - e. Wetted O-Rings: Glass-filled TFE, graphite-filled PTFE, or Viton, unless otherwise noted.
 - f. Bolts and Nuts (if required): Type 316 stainless steel, unless otherwise noted.
 - g. Fill Fluid: Silicone, unless otherwise noted.
- 4. Process Connections:
 - a. Line Size: 1/2 inch.
 - b. Connection Type: FNPT.
 - c. Direct/Remote Diaphragm Seal: If and as noted.
- 5. Signal Interface:
 - a. 4 mA dc to 20 mA dc output with digital signal based on HART protocol, unless otherwise noted below.
 - 1) Nominal Maximum Loop Resistance with External 24V dc Power Supply: 550 ohms.

GRFF OZONE SYSTEM REPLACEMENT

6. Enclosure:
 - a. Type: NEMA 4X.
 - b. Materials: Coated aluminum, unless otherwise noted.
 - c. Mounting bracket, unless otherwise noted.
 - 1) Bracket and Accessories: Stainless steel; suitable for mounting transmitter to panel or 2-inch pipe.
 7. Accessories:
 - a. Three-valve manifold, unless otherwise noted.
 - 1) Includes one equalization and two isolation valves.
 - 2) Type 316 stainless steel.
 8. Manufacturers and Products:
 - a. E&H; PMD75.
 - b. Siemens; Model P320.
 - c. Rosemount; Model 3051 CD.
 - d. "Or-equal."
- K. P4 Pressure Gauge:
1. General:
 - a. Function: Local pressure indication.
 - b. Type: Bourdon tube element.
 2. Performance:
 - a. Scale Range: As noted.
 - b. Accuracy: Plus or minus 0.50 percent of full scale.
 3. Features:
 - a. Dial: 4-1/2-inch diameter.
 - b. Pointer Vibration Reduction: Required, unless otherwise noted.
 - 1) Use the following method:
 - a) Liquid filled gauge front, unless otherwise noted.
 - (1) Glycerine fill, unless otherwise noted.
 - c. Case Material: Black thermoplastic, unless otherwise noted.
 - d. Materials of Wetted Parts (including element, socket/process connection, throttling device (if specified) and secondary components):
 - 1) Stainless steel, unless otherwise noted.
 - e. Pointer: Adjustable by removing ring and window.
 - f. Window: Glass or acrylic, unless otherwise noted.
 - g. Threaded reinforced polypropylene front ring.
 - h. Case Type: Solid front with blow-out back.
 4. Process Connection:
 - a. Mounting: Lower stem, unless otherwise noted.
 - b. Size: 1/2-inch MNPT, unless otherwise noted.

GRFF OZONE SYSTEM REPLACEMENT

5. Accessories:
 - a. Throttling Device: Required, unless otherwise noted.
 - 1) Type suitable for the intended service.
 - 2) Install in gauge socket bore.
6. Manufacturers and Products:
 - a. Ashcroft; Duragauge Model, 1279 PLUS!
 - b. Ametek U.S. Gauge; Solfrunt Model 19XX/1981Advantatge.
 - c. WIKA, Type 2XX.34.
 - d. "Or-equal."

L. P5 Pressure Differential Indicator:

1. General:
 - a. Function: Pressure differential indication.
2. Performance:
 - a. Range: 0 – 5.0 in H₂O.
 - b. Accuracy: Plus or minus 0.5 percent of full scale.
 - c. Static Pressure Rating: 500 psig.
3. Features:
 - a. Case:
 - 1) Stainless steel.
 - 2) Viton sealed.
 - b. Dial Size: 6 inches.
 - c. Pointer:
 - 1) Black painted aluminum.
 - 2) External adjust feature (to 25 percent of range).
 - d. Window: Shatterproof glass.
 - e. Diaphragm Material: Type 316 stainless steel.
 - f. Diaphragm Fill Fluid: None.
 - g. Three-way manifold.
 - h. Housing: Type 316 stainless steel with Viton O-ring.
4. Process Connection:
 - a. 1/4-NPTF.
 - b. Lower connection.
5. Mounting: Wall/backplane.
6. Manufacturer and Product: Ashcroft; Type 5503; O3ONIA.

M. P6 Pressure Seal, Diaphragm:

1. General:
 - a. Function: Isolate sensing element from process fluid.
 - b. Type:
 - 1) Diaphragm.
 - 2) Fluid filled between diaphragm and sensing element.

2. Service:
 - a. Pressure: Same as associated sensor.
 - b. Temperature Range: If noted.
3. Performance:
 - a. Pressure:
 - 1) For threaded process connections, at least 2,500 psig at 100 degrees F.
 - 2) Glycerin Fill: Suitable only for pressure (not vacuum applications).
 - b. Temperature: Dependent upon fill fluid; minus 40 degrees F to plus 250 degrees F.
4. Features:
 - a. Materials:
 - 1) Lower Housing: Type 316 stainless steel, unless otherwise noted.
 - 2) Diaphragm Material: Type 316 stainless steel, unless otherwise noted.
 - 3) Top Housing: Steel, unless otherwise noted.
 - b. Diaphragm: Welded to upper housing, unless otherwise noted.
 - c. Filling screw in upper housing.
 - d. Fill Fluid:
 - 1) As noted.
 - 2) "Or-equal."
 - 3) Factory assembled and filled.
 - e. Flushing Connection: 1/4-inch NPT in lower housing.
 - f. Diaphragm Seal Displacement: 0.1 cubic inch, nominal.
5. Connections:
 - a. Instrument: 1/2-inch female NPT, unless otherwise noted or shown.
 - b. Process: 1/2-inch female NPT, unless otherwise noted or shown.
6. Manufacturers and Products:
 - a. Ashcroft; Type 201.
 - b. Ametek; Mansfield and Green Division; Type SG.
 - c. WIKA; Type L990.10.
 - d. "Or-equal."

N. P8 Pressure Switch, Fixed Deadband:

1. General:
 - a. Function: Monitor pressure.
 - b. Type: Diaphragm actuated switch.
2. Performance:
 - a. Setpoint:
 - 1) As noted.
 - 2) Repeatability: Plus or minus 1 percent.

GRFF OZONE SYSTEM REPLACEMENT

- b. Range: Noted setpoint shall fall between 20 percent and 80 percent of range.
 - c. Overpressure Proof Pressure: At least 400 percent of rated maximum static pressure.
- 3. Features:
 - a. Actuator Seal: Teflon, unless otherwise noted.
 - b. Differential (deadband): Fixed.
 - c. Reset: Automatic, unless otherwise noted.
 - d. Mounting: Surface, unless otherwise noted.
 - e. Diaphragm Material: Teflon.
- 4. Process Connection:
 - a. 1/4-inch NPT female connections, unless otherwise noted.
 - b. Materials: Nickel-plated brass, unless otherwise noted.
- 5. Enclosure: NEMA 4X.
- 6. Signal Interface:
 - a. Contact Type:
 - 1) SPDT, unless otherwise noted.
 - 2) Rated for 10 amps minimum at 120V ac.
 - b. Hermetically Sealed Switch: If noted.
- 7. Manufacturers and Products:
 - a. Ashcroft; Type 400, B Series.
 - b. United Electric; 400 Series.
 - c. "Or-equal."

O. P9 Pressure Transmitter:

- 1. General:
 - a. Function: Measure pressure and transmit signal proportional to pressure.
 - b. Type:
 - 1) Electronic variable capacitance or silicon strain gauge.
 - 2) Two-wire transmitter; "smart electronics."
 - c. Parts: Transmitter and accessories.
- 2. Performance:
 - a. Range: As noted.
 - 1) Select transmitter's factory upper range limit (URL) such that upper boundary of noted range is as close as possible to 80 percent of factory URL, but does not exceed it.
 - b. Accuracy: Plus or minus 0.075 percent of span, unless otherwise noted.
 - c. Ambient Operating Temperature: Minus 40 degrees F to plus 175 degrees F, with integral meter.
 - d. Process Operating Temperature: Minus 40 degrees F to plus 250 degrees F.

GRFF OZONE SYSTEM REPLACEMENT

- e. Humidity: 0 percent to 100 percent relative humidity.
- f. Hazardous Location Certifications: If and as noted.
- 3. Features:
 - a. Type: Gauge pressure, unless otherwise noted.
 - b. Adjustable damping.
 - c. LCD indicator, unless otherwise noted: Display in either percent or engineering units, field configurable.
 - d. Wetted Metallic Parts: Type 316 stainless steel, unless otherwise noted.
 - 1) Includes drain/vent valves; process flanges and adapters, and process isolating diaphragm.
 - e. Wetted O-Rings: Glass filled TFE, graphite filled PTFE, or Viton, unless otherwise noted.
 - f. Bolts and Nuts (if required): Type 316 stainless steel, unless otherwise noted.
 - g. Fill Fluid: Silicone, unless otherwise noted.
- 4. Process Connections:
 - a. Line Size: 1/2 inch or 1/4 inch.
 - b. Connection Type: FNPT.
 - c. Direct/remote Diaphragm Seal: If and as noted.
- 5. Signal Interface:
 - a. 4mA dc to 20 mA dc output with digital signal based on HART protocol, unless otherwise noted below.
 - 1) Nominal Maximum Loop Resistance with External 24V dc Power Supply: 550 ohms.
- 6. Enclosure:
 - a. Type: NEMA 4X.
 - b. Materials: Coated aluminum, unless otherwise noted.
 - c. Mounting bracket, unless otherwise noted.
 - 1) Bracket and Accessories: Stainless steel; suitable for mounting transmitter to panel or 2-inch pipe.
- 7. Accessories:
 - a. Two-valve (isolate and vent) Stainless Steel Manifold: If noted.
- 8. Manufacturers and Products:
 - a. Gauge Pressure Units:
 - 1) E&H.
 - 2) Rosemount; Model 3051 TG.
 - 3) Foxboro; Model IGP20.
 - 4) SMAR; LD30XM Series.
 - b. Absolute Pressure Units:
 - 1) E&H; PMP71.
 - 2) Rosemount; Model 3051 TA.
 - 3) Siemens; Model P320.

GRFF OZONE SYSTEM REPLACEMENT

P. T3 Temperature Element and Transmitter, Resistance:

1. General:
 - a. Function: Measure temperature of process fluid and transmit analog signal proportional to temperature.
 - b. Type: RTD.
 - c. Parts: Element, thermowell, and transmitter.
2. Service:
 - a. Process Fluid: As noted.
 - b. Process Temperature Range: As noted.
3. Element:
 - a. Type:
 - 1) Single element, unless otherwise noted.
 - 2) Three-wire, RTD.
 - 3) Platinum, 100 ohm nominal at 0 degree C.
 - b. Performance:
 - 1) Sensor Accuracy for 900 degrees F and Below: Plus or minus 0.5 degree F or plus or minus 0.25 percent of reading, whichever is larger.
 - c. Features:
 - 1) Dimensions (bare element): 1/4-inch diameter.
 - 2) Length to accommodate thermowell insertion and extension length.
 - 3) Spring-loaded element when thermowell is used.
 - 4) Sheath:
 - a) Type 316 stainless steel, unless otherwise noted.
 - b) Process Operating Temperature Range: Minus 320 degrees F to 900 degrees F, unless otherwise noted.
 - 5) Terminal Connection Head:
 - a) General purpose, NEMA 4 weatherproof, unless otherwise noted.
 - b) Maximum Ambient Temperature: 220 degrees F, unless otherwise noted.
 - 6) Thermowell Connection: Union coupler, stainless steel, unless otherwise noted.
 - 7) Sensitive Length: 1.6 inch minimum, measured from closed end.
4. Thermowell:
 - a. Features:
 - 1) Inside Diameter: Sized to match thermocouple.
 - 2) Material: Type 316 stainless steel, unless otherwise noted.
 - 3) Insertion Length: As noted.
 - 4) Extension Length: 3 inches, unless otherwise noted.

- b. Process Connection: 1-inch NPT connection, unless otherwise noted.
 - c. Well Type: Threaded straight, unless otherwise noted.
- 5. Transmitter:
 - a. Ambient Operation Conditions:
 - 1) Temperature: Minus 20 degrees F to 158 degrees F, with display.
 - 2) Relative Humidity: 0 percent to 100 percent, noncondensing.
 - b. Type: Two-wire, powered by remote power supply.
 - c. Performance:
 - 1) Digital Accuracy: Greater of plus or minus 0.09 degree F or plus or minus 0.01 percent of span.
 - 2) Response Time: 1.2 second 90 percent response time for 80 percent input step, with minimum damping.
 - d. Electrical Safety: Standard unless otherwise noted.
 - e. Features:
 - 1) Indicator: Three-line LCD, unless otherwise noted.
 - 2) Automatic reference junction compensation.
 - 3) Failsafe Mode:
 - a) User configurable ON, unless otherwise noted.
 - b) Downscale, unless otherwise noted.
 - 4) Electric Damping: 1.2 seconds.
 - f. Signal Interface: 4 mA dc to 20 mA dc.
 - g. Power: 24V dc external power supply.
 - h. Digital Communication: HART.
 - 1) Supply one HART communicator for HART capable transmitters, if not already supplied under another specification section.
 - i. Enclosure:
 - 1) Materials: Epoxy-coated, low-copper aluminum, unless otherwise noted.
 - 2) Type: NEMA 4X.
 - 3) Mounting: Wall, pipe stand, or integral to thermowell, as noted.
 - a) For pipe stand, provide stainless steel mounting set, unless otherwise noted.
 - b) For integral thermowell mount, provide explosion-proof connection.
- 6. Manufacturers and Products:
 - a. Endress + Hauser; TMT162 RTD, Thermowell and Transmitter.
 - b. Rosemount; 78 Series Platinum RTD with Thermowell and Model 644H Transmitter.
 - c. Siemens; TS500 housing with tapered thermowell, TH320 Transmitter, and RD150 display.

GRFF OZONE SYSTEM REPLACEMENT

- d. Invensys/Foxboro; RTT20 Series Transmitter with PR Series RTD and T-Series Thermowell.
- e. "Or-equal."

Q. T4 Temperature Element and Transmitter, Thermocouple:

- 1. General:
 - a. Function: Measure temperature of process fluid and transmit analog signal proportional to temperature.
 - b. Type: Thermocouple.
 - c. Parts: Element, thermowell, and transmitter.
- 2. Service:
 - a. Process Fluid: As noted.
 - b. Process Temperature Range: As noted.
- 3. Element:
 - a. Type:
 - 1) Single-element, unless otherwise noted.
 - 2) Iron-constantan, Type J, ungrounded, unless otherwise noted.
 - b. Performance:
 - 1) Accuracy: Plus or minus 4 degrees F or plus or minus 0.75 percent of reading, whichever is greater.
 - c. Features:
 - 1) Dimensions (Bare Element): 1/4-inch diameter.
 - 2) Length to accommodate thermowell insertion and extension length.
 - 3) Spring-loaded element when well is used.
 - 4) Sheath:
 - a) Type 316 stainless steel, unless otherwise noted.
 - b) Process Operating Temperature:
 - (1) Range: Minus 320 degrees F to 1,600 degrees F, unless otherwise noted.
 - 5) Terminal Connection Head:
 - a) General purpose, NEMA 4 weatherproof, unless otherwise noted.
 - b) Maximum Temperature: 220 degrees F, unless otherwise noted.
 - 6) Thermowell Connection: Union coupler, stainless steel, unless otherwise noted.
 - 7) Sensitive Length: 1.6 inch minimum, measured from closed end.
- 4. Thermowell:
 - a. Features:
 - 1) Inside Diameter: Sized to match thermocouple.
 - 2) Material: Type 316 stainless steel, unless otherwise noted.

GRFF OZONE SYSTEM REPLACEMENT

- 3) Insertion Length: As noted.
 - 4) Extension Length: 3 inches, unless otherwise noted.
 - b. Process Connection: 1-inch NPT connection, unless otherwise noted.
 - c. Well Type: Threaded straight, unless otherwise noted.
- 5. Transmitter:
 - a. Ambient Operation Conditions:
 - 1) Temperature: Minus 20 degrees F to 158 degrees F, with display.
 - 2) Relative Humidity: 0 percent to 100 percent, noncondensing.
 - b. Type: Two-wire, powered by a remote power supply.
 - c. Performance:
 - 1) Digital Accuracy: Greater of plus or minus 0.07 degree F or plus or minus 0.01 percent of span.
 - 2) Response Time: 1.2 second 90 percent response time for 80 percent input step, with minimum damping.
 - d. Electrical Safety: Standard unless otherwise noted.
 - e. Features:
 - 1) Indicator: Three line LCD, unless otherwise noted.
 - 2) Automatic reference junction compensation.
 - 3) Failsafe Mode:
 - a) User configurable ON, unless otherwise noted.
 - b) Downscale, unless otherwise noted.
 - 4) Electric Damping: 1.2 seconds.
 - f. Signal Interface: 4 mA dc to 20 mA dc.
 - g. Power: 24V dc external power supply.
 - h. Digital Communication: HART.
 - 1) One HART communicator to be supplied for all HART capable transmitters, if not already supplied under another specification section.
 - i. Enclosure:
 - 1) Materials: Epoxy-coated, low-copper aluminum, unless otherwise noted.
 - 2) Type: NEMA 4X.
 - 3) Mounting: Wall, pipe stand, or integral to thermowell, as noted.
 - a) For pipe stand, provide stainless steel mounting set, unless otherwise noted.
 - b) For integral thermowell mount, provide explosion-proof connection.

GRFF OZONE SYSTEM REPLACEMENT

6. Manufacturers and Products:
 - a. Rosemount; Series 183 Thermocouple and Thermowell, and Model 644H Transmitter.
 - b. Siemens; TS500 housing with tapered thermowell, TH320 Transmitter, and RD150 display.
 - c. Invensys/Foxboro; RTT20 Series Transmitter with MINOX MT Series Thermocouple and Thermowell.
 - d. "Or-equal."
- R. T5 Temperature Switch:
 1. General:
 - a. Function: Provide change in contacts as temperature rises or falls through noted setpoint.
 - b. Type:
 - 1) Vapor pressure thermal bulb sensing element.
 - 2) Fixed differential, unless otherwise noted.
 - c. Parts: Switch/element assembly and thermowell.
 2. Performance:
 - a. Setpoint: As noted.
 - b. Range: Such that noted setpoint falls between 30 percent and 70 percent of range.
 - c. Repeatability: Plus or minus 1 percent of span.
 3. Switch:
 - a. Type: Snap action, SPDT, sealed environment proof, unless otherwise noted.
 - b. Rating: 125V ac 15A, unless otherwise noted.
 - c. Reset: Automatic.
 - d. Enclosure:
 - 1) Type: NEMA 4X, unless otherwise noted.
 - 2) Mounting:
 - a) Direct mount, unless otherwise noted.
 - b) If remote mounted, furnish capillary with length either as noted or as required.
 4. Element:
 - a. Type: Bulb.
 - b. Stem mounted to thermowell.
 - c. Length: Coordinate with thermowell insertion length.
 5. Thermowell:
 - a. Process Connection: 1/2-inch NPT(M).
 - b. Material: Type 316 stainless steel or Type 304 stainless steel.
 - c. Insertion Length: 3-1/2-inch minimum immersion for liquids and 5-1/2-inch minimum immersion for gases, unless otherwise noted.

6. Electrical Connections:
 - a. Conduit: 1/2-inch NPT(F).
 7. Manufacturers:
 - a. Ashcroft; B Series (Type 400 NEMA 4X, Type 700 NEMA 7 and NEMA 9).
 - b. Barksdale; ML1H, MT1H.
- S. T9 Thermometer, Bimetallic, Adjustable Angle:
1. General:
 - a. Function: Indicate process temperature.
 - b. Type: Bi-metallic, circular dial.
 - c. Parts: Temperature gauge and thermowell.
 2. Performance:
 - a. Scale Range: As noted.
 - b. Accuracy: 1 percent of full scale.
 3. Thermometer Features:
 - a. Stem Length: 4 inches, unless otherwise noted.
 - b. Stem Type:
 - 1) Every angle, unless otherwise noted.
 - a) Adjustable 90 degrees vertical, 360 degrees horizontal.
 - c. Dial:
 - 1) Heavy-duty glass, unless otherwise noted.
 - 2) 5-inch circular, unless otherwise noted.
 - 3) Hermetically sealed.
 - d. Construction: All-welded, stainless steel.
 4. Thermowell:
 - a. Type: 1/2-inch NPT connection, Type 316 stainless steel.
 - b. Extension Neck: When noted, with length as noted.
 5. Manufacturers and Products:
 - a. Ashcroft; Series EI bimetal thermometer.
 - b. WIKA; Type S5301 bimetal thermometer.

2.01 SPARE PARTS

- A. Provide one spare A44 ambient ozone analyzer.
- B. Furnish complete all equipment requiring periodic repair, adjustment, or calibration, with all special tools, instruments, and accessories required for proper maintenance.
- C. Contain spare parts in suitable boxes clearly marked as to content.

GRFF OZONE SYSTEM REPLACEMENT

PART 3 EXECUTION

3.01 SUPPLEMENT

- A. The supplement listed below, following “End of Section,” is a part of this specification:
 - 1. Instrument List.

END OF SECTION

INSTRUMENT LIST

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
PI-35111	LOX Tank 1 Pressure Gauge	P4	NOSHOK		Range	0 to 400 psig	08-I-101	Replace
LI-35111	LOX Tank 1 Level Gauge	P4	Barton 227		Range	0 to 600 in H ₂ O	08-I-101	Replace
LIT-35111	LOX Tank 1 Level Transmitter	P3	E&H PMD75-ABC7H41DC3U (should be 3 for Oxygen service)	See Note 1	Scale Range	0 to 1,200 in H ₂ O	08-I-101	Replace
PIT-35111	LOX Tank 1 Pressure Transmitter	P9	E&H PMP71-ABC1SB1RHN3U		Scale Range	0 to 400 psi	08-I-101	Replace
PSH-35111	LOX Tank 1 Pressure Switch - High	P8	Unite Electric Series 400		Setpoint	150 psig	08-I-101	Replace
PI-35112	LOX Tank 2 Pressure Gauge	P4	NOSHOK		Range	0 to 400 psig	08-I-101	Replace
LI-35112	LOX Tank 2 Level Gauge		Barton 227		Range	0 to 600 in H ₂ O	08-I-101	Replace
LIT-35112	LOX Tank 2 Level Transmitter	P3	E&H; PMD75-ABC7H41D33U	See Note 1	Scale Range	0 to 1,200 in H ₂ O	08-I-101	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
PIT-35112	LOX Tank 2 Pressure Transmitter	P9	E&H; PMP71- ABC1SB1RHN3U		Scale Range	0 to 400 psi	08-I-101	Replace
PSH-35112	LOX Tank 2 Pressure Switch - High	P8	Unite Electric Series 400 ? - no name plate on pics	No existing instrument support	Setpoint	150 psig	08-I-101	Replace
TE-35321 TIT-35321	GOX Temperature Element, Well and Transmitter	T3	E&H; TMT162- A21131bka TH13-2A221AA	316SS TW 1.5" Insertion, 3" lag. 3/4 NPT	RTD Range Output Range	-320 to 900°F -30 to 120°F	08-I-101	Replace
PDIT-35421	GOX Differential Pressure (particulate filter)	P3	E & H; PMD75- ABC7F61D3BA	See Note 1	Scale Range	0 to 7.5 psi	08-I-101	Replace
PIT-35511	GOX Feed to Generator Pressure	P9	E&H; PMP71- ABC1MB1RHN3U		Range	0 to 60 psi	08-I-101	Replace
TI-35211	Vaporizer 1 Outlet Temperature Gauge	T9	Ashcroft		Scale Range	-20 to 120°F	08-I-101	Replace
TI-35212	Vaporizer 2 Outlet Temperature Gauge	T9	Ashcroft		Scale Range	-20 to 120°F	08-I-101	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
PI-35411A	GOX Pressure Gauge - Upstream Pressure Regulation Valve	P4	Ashcroft		Scale Range	0 to 100 psi	08-I-101	Replace
PI-35411B	GOX Pressure Gauge - Downstream Pressure Regulation Valve	P4	Ashcroft		Scale Range	0 to 100 psi	08-I-101	Replace
FE-31251 FIT-31251	Ozone Generator 1 Cooling Water Supply Flowrate	F4	Electromagnetic E&H; 50P1H-EROA1AA0BAAA	Inline, 4" ANSI 150 Flange	Flow Range	0 to 250 gpm	08-I-102	Replace
PIT-31131	Ozone Generator 1 GOX Pressure Transmitter	P9	E&H PMP71-ABC1MB1RHN3U	1/2" NPT	Setpoint	0 to 30 psig	08-I-102	Replace
TE-31161 TIT-31161	Ozone Generator 1 Ozone Temperature Temperature Element, Well and Transmitter	T3	E&H TMT162-A21131bka TH13-2A221AA Sensor	316SS TW 1.5" Insertion, 3" lag 3/4 NPT"	RTD Range Output Range	-320 to 900°F 30 to 160°F	08-I-102	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
TE-31261 TIT-31261	Ozone Generator 1 Cooling Water Return Temperature	T3	E&H TMT162-A21131bka TH13-2A22E1AA Sensor	316SS TW 1.5" Insertion, 3" lag 3/4 NPT"	RTD Range Output Range	-320 to 900°F 30 to 120°F	08-I-102	Replace
TI-31101	Ozone Generator 1 GOX Temperature Thermal Meter	T9	Ashcroft		Scale Range	-20 to 120°F	08-I-102	Replace
TI-31221	Ozone Generator 1 Cooling Water Supply Temperature	T9	ASHCROFT 50-EI-60E040XNH	316SS TW, Straight, 3/4" NPT, U = 1-5/8"	Scale Range	30 to 130°F	08-I-102	Replace
PI-31241	Ozone Generator 1 Cooling Water Supply Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2 NPT	Scale Range	0 to 60 psi	08-I-102	Replace
PI-31171	Ozone Generator 1 Ozone Pressure	P4	Ashcroft; Duragauge		Scale Range	0 to 30 psi	08-I-102	Replace
FE-31252 FIT-31252	Ozone Generator 2 Cooling Water Supply Flowrate	F4	Electromagnetic E&H; 50P1H-EROA1AA0BAAA	Inline, 4" ANSI 150 Flange	Flow Range	0 to 250 gpm	08-I-102	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
PIT-31132	Ozone Generator 2 GOX pressure transmitter	P9	E&H; PMP71- ABC1MB1RHN3U	1/2" NPT	Setpoint	0 to 30 psi	08-I-102	Replace
TE-31162 TIT-31162	Ozone Generator 2 Ozone Temperature Temperature Element, Well and Transmitter	T3	E&H TMT162- A21131bka TH13-2A221AA Sensor	316SS TW 1.5" Insertion, 3" lag 3/4 NPT"	RTD Range Output Range	-320 to 900°F 30 to 160°F	08-I-102	Replace
TE-31262 TIT-31262	Ozone Generator 2 Cooling Water Return Temperature	T3	E&H TMT162- A21131bka TH13-2A22E1AA Sensor	316SS TW 1.5" Insertion, 3" lag 3/4 NPT"	RTD Range Output Range	-320 to 900°F 30 to 120°F	08-I-102	Replace
TI-31102	Ozone Generator 2 GOX Temperature	T9	Ashcroft		Scale Range	-20 to 120°F	08-I-102	Replace
TI-31222	Ozone Generator 2 Cooling Water Supply Temperature	T9	ASHCROFT 50-EI-60E040XNH"	316SS TW, Straight, 3/4" NPT, U = 1-5/8"	Scale Range	30 to 130°F	08-I-102	Replace
PI-31242	Ozone Generator 2 Cooling Water Supply Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2 NPT	Scale Range	0 to 60 psi	08-I-102	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
PI-31172	Ozone Generator 2 Ozone Pressure	P4	Ashcroft; Duragauge		Scale Range	0 to 30 psi	08-I-102	Replace
FE-31271 FIT-31271	Power Supply Unit 1 Cooling Water Flowrate	F4	Electromagnetic E&H; 50P50- EF0A1A4CBAAA	Inline, 2" ANSI 150 Flange	Flow Range	0 to 50 gpm	08-I-102	Replace
FE-31272 FIT-31272	Power Supply Unit 2 Cooling Water Flowrate	F4	Electromagnetic E&H; 50P50- EF0A1A4CBAAA	Inline, 2" ANSI 150 Flange	Flow Range	0 to 50 gpm	08-I-102	Replace
AE-31011 AIT-31011	Ambient Oxygen Element and Analyzer/Transmitter	A29	MSA A-UltimaX-E-14-E- 1-S-03020001TC	Wall Mount	RANGE ALARM - High ALARM – High High	0 to 25% 22% (rising) 24.5% (rising)"	08-I-102	Replace
AE-31021 AIT-31021	Ambient Ozone Element and Analyzer/Transmitter	A44	IN USA IN-2000 L2-LC	Wall Mount	Cal. range Alarm Interlock	0 to 1 ppm 0.08 ppm (rising), 0.3 ppm	08-I-102	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
TE-31571 TIT-31571	Nitrogen Boost Temperature Element, Well and Transmitter	T3	E&H TMT162-A21131bka TH13-2A221AA Sensor	316SS TW 1.5" Insertion, 3" lag, 3/4 NPT	RTD Range Output Range	-320 to 900°F 30 to 160°F	08-I-103	Replace
PIT-31541	Nitrogen Discharge Pressure	P9	E&H PMP71-ABC1MB1RHN3U	1/2" FNPT	Scale Range	0 to 60 psi	08-I-103	Replace
PSL-31521	Air Receiver Tank Pressure Switch Low	P8	Ashcroft; B420T XMFS07	1/4" tubing	Range Setpoint	100 psi 70 psi	08-I-103	Replace
TSH-31521	Air Receiver Tank Temperature Switch High	T5	ASCHROFT T420TS027 XFSNH	316 SS TW, Tapered, 3/4" NPT, U= 2-1/2"	Cal. Range SETPOINT	70 to 205°F 100°F	08-I-103	Replace
PI-31521	Nitrogen Boost Air Receiver Pressure	P4		1/2" NPT Horizontal without support	Scale Range	0 to 200 psi	08-I-103	Replace
PI-31551A	N2 Pressure Gauge 1	P4	DIXON GL340	1/2" NPT share same process connection with PIT-31541	Scale Range	0 to 200 psi	08-I-103	Replace
PI-31551B	N2 Pressure Gauge 2	P4	ASHCROFT DURAGUGE	1/2" NPT	Scale Range	0 to 100 psi	08-I-103	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
TE-31321 TIT-31321	Open Loop CWS Pump 1 Temperature	T4	E&H TMT162- A21131bka TH13-2A221AA Sensor	316SS TW, 2.5" Insertion, 3" lag, 3/4" NPT	Scale Range	30 to 120°F	08-I- 104	Replace
PI-31311A	Heat Rejection Pump 1 Feed Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I- 104	Replace
PI-31311B	Heat Rejection Pump 1 Discharge Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I- 104	Replace
TE-31322 TIT-31322	Open Loop CWS Pump 2 Temperature	T4	E&H TMT162- A21131bka TH13-2A221AA Sensor	316SS TW, 2.5" Insertion, 3" lag, 3/4" NPT	Scale Range	30 to 120 °F	08-I- 104	Replace
PI-31312A	Heat Rejection Pump 2 Feed Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I- 104	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
PI-31312B	Heat Rejection Pump 2 Discharge Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-104	Replace
TIT-31323	Open Loop CWS Pump 3 Temperature	T4	E&H TMT162- A21131bka TH13-2A221AA Sensor	316SS TW, 2.5" Insertion, 3" lag, 3/4" NPT	Scale Range	30 to 120°F	08-I-104	Replace
PI-31313A	Heat Rejection Pump 3 Feed Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-104	Replace
PI-31313B	Heat Rejection Pump 3 Discharge Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-104	Replace
DPIT-31301	Raw Water Strainer 1 Differential Pressure Transmitter	P3		See Note 1			08-I-104	New

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
TI-31331A	Heat Exchanger 1 CWS Temperature	T9	ASHCROFT 50-EI-60E040XNH	316SS TW, Straight, U = 1-5/8" 3/4"NPT	Scale Range	30 to 130°F	08-I- 104	Replace
PI-31351A	Heat Exchanger 1 CWS Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I- 104	Replace
FI/FSL- 31341	Heat Exchanger 1 CWS Flow Indicator	F18	KOBOLD DWS-7200	316 SS, 4" RF Flange	Range Setpoint Totalizer Units	0 to 250 pgm gal x 10,000	08-I- 104	Replace
TI-31331B	Heat Exchanger 1 CWR Temperature	T9	ASHCROFT 50-EI-60E040XNH	316SS TW, Straight, U = 1-5/8" 3/4"NPT	Scale Range	30 to 130°F	08-I- 104	Replace
PI-31351B	Heat Exchanger 1 CWR Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I- 104	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
PI-31451	Heat Exchanger 1 GCWR Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-104	Replace
TI-31431B	Heat Exchanger 1 GCWR Temperature	T9	ASHCROFT 50-EI-60E040XNH	316SS TW, Straight, U = 1-5/8" 3/4"NPT	Scale Range	30 to 130°F	08-I-104	Replace
PI-31481	Expansion Tank 1 Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-104	Replace
LSL-31481	Expansion Tank 1 Level Switch Low	L2	AMETEK Z-TRON III Z002-05 with 700-0206-201 Sensor	3/4" NPT			08-I-104	Replace
PI-31411	Coolant Water Pump 1 GCWS Discharge Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-104	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
TE-31421 TIT-31421	Coolant Water Pump 1 GCWS Temperature	T4	E&H TMT162- A21131bka TH13-2A22E1AA Sensor	316SS TW, 2.5" Insertion, 3" lag 3/4 NPT	RTD Range Output Range	-320 to 900°F 30 to 120°F	08-I- 104	Replace
FI-31441	Coolant Water Pump 1 GCWS Flowrate	F18	KOBOLD; DWU - 7200	316 SS, 4" RF Flange	Scale Range	62.5 to 250 gpm	08-I- 104	Replace
TI-31431A	Coolant Water Pump 1 GCWS Discharge Temperature	T9	ASHCROFT 50-EI-60E040XNH	316SS TW, Straight, U = 1-5/8" 3/4"NPT	Scale Range	30 to 130°F	08-I- 104	Replace
DPIT-31302	Raw Water Strainer 2 Differential Pressure Transmitter	P3		See Note 1			08-I- 104	New
TI-31332A	Heat Exchanger 2 CWS Temperature	T9	ASHCROFT 50-EI-60E040XNH	316SS TW, Straight, U = 1-5/8" 3/4"NPT	Scale Range	30 to 130°F	08-I- 104	Replace
PI-31352A	Heat Exchanger 2 CWS Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I- 104	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
FI/FSL-31342	Heat Exchanger 2 CWS Flow Indicator	F18	KOBOLD DWS-7200	316 SS, 4" RF Flange	Range Setpoint Totalizer Units	0 – 250 gpm (gal x 10,000)	08-I-104	Replace
TI-31332B	Heat Exchanger 2 CWR Temperature	T9	ASHCROFT 50-EI-60E040XNH	316SS TW, Straight, U = 1-5/8" 3/4"NPT	Scale Range	30 to 130°F	08-I-104	Replace
PI-31352B	Heat Exchanger 2 CWR Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-104	Replace
PI-31452	Heat Exchanger 2 GCWR Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-104	Replace
TI-31432B	Heat Exchanger 2 GCWR Temperature	T9	ASHCROFT 50-EI-60E040XNH	316SS TW, Straight, U = 1-5/8" 3/4"NPT	Scale Range	30 to 130°F	08-I-104	Replace
PI-31482	Expansion Tank 2 Pressure	P4	Ashcroft; Duragauge	1/2" NPT	Scale Range	0 to 60 psi	08-I-104	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
LSL-31482	Expansion Tank 2 Level Switch Low	L2	AMETEK Z-TRON III Z002-05 with 700-0206-201 Sensor	3/4" NPT			08-I-104	Replace
PI-31412	Coolant Water Pump 2 GCWS Discharge Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-104	Replace
TE-31422 TIT-31422	Coolant Water Pump 2 GCWS Temperature	T4	E&H TMT162- A21131bka TH13-2A22E1AA Sensor	316SS TW, 2.5" Insertion, 3" lag 3/4 NPT	RTD Range Output Range	-320 to 900°F 30 to 120°F	08-I-104	Replace
FI-31442	Coolant Water Pump 2 GCWS Flowrate	F18	KOBOLD; DWU - 7200	316 SS, 4" RF Flange	Scale Range	62.5 to 250 gpm	08-I-104	Replace
TI-31432A	Coolant Water Pump 2 GCWS Discharge Temperature	T9	ASHCROFT 50-EI-60E040XNH	316SS TW, Straight, U = 1-5/8" 3/4"NPT	Scale Range	30 to 130°F	08-I-104	Replace
LSH-31041	Cooling Water Drain Sump Level Switch High	L2					08-I-104	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
PE-32121A PI-32121	Ozone to R1 Injector Pressure 1	P4	Ashcroft; Duralife	1/2" NPT	Scale Range Fluid fill	30 inHg vac to 30 psi Glycerine	08-I-105	Replace
PE-32121B PSL-32121	Ozone to R1 Injector Pressure Switch Low 1	P8	Ashcroft; B420T XFMSNH076B	1/2" NPT	Setpoint	5 psi	08-I-105	Replace
PE-32122A PI-32122	Ozone to R1 Injector Pressure 2	P4	Ashcroft; Duralife	1/2" NPT	Scale Range Fluid fill	30 inHg vac to 30 psi Glycerine	08-I-105	Replace
PE-32122B PSL-32122	Ozone to R1 Injector Pressure Switch Low 2	P8	Ashcroft; B420T XFMSNH076B	1/2" NPT	Setpoint	5 psi	08-I-105	Replace
PI-32131A	R1 Injector Pump 1 Feed Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-105	Replace
PI-32131B	R1 Injector Pump 1 Discharge Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-105	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
PSL-32131B	R1 Injector Pump 1 Discharge Pressure Switch Low	P8	ASHCROFT B420B-XNHX07	316SS, 1/2" NPT	Unit Range Setpoint	0 to 30 psi 12 psi (decreasing)	08-I-105	Replace
PI-32132A	R1 Injector Pump 2 Feed Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-105	Replace
PI-32132B	R1 Injector Pump 2 Discharge Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-105	Replace
PSL-32132B	R1 Injector Pump 2 Discharge Pressure Switch Low	P8	ASHCROFT B420B-XNHX07	316SS, 1/2" NPT	Unit Range Setpoint	0 to 30 psi 12 psi (decreasing)	08-I-105	Replace
PI-32133A	R1 Injector Pump 3 Feed Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-105	Replace
PI-32133B	R1 Injector Pump 3 Discharge Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-105	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
PSL-32133B	R1 Injector Pump 3 Discharge Pressure Switch Low	P8	ASHCROFT B420B-XNHX07	316SS, 1/2" NPT	Unit Range Setpoint	0 to 30 psi 12 psi (decreasing)	08-I-105	Replace
FE-32151 FIT-32151	R1 Sidestream Injector 1 Flowrate	F4	Electromagnetic Flowmeter E&H; PROMGAG 50 50PF-ER0A1AA0BAAA	Inline, 316SS, 6" ANSI 150 Flange	Range	0 to 1,000 pgm	08-I-105	Replace
PI-32141A	R1 Injector 1 Water Feed Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-105	Replace
PI-32141B	R1 Injector 1 Ozone Gas Pressure	P4	Ashcroft, Duragauge	1/2" NPT	Scale Range	0 to 30 psi	08-I-105	Replace
PE-32141C PI-32141C	R1 Injector 1 Ozonated Water Pressure	P4	Ashcroft, Duralife	1/2" NPT	Scale Range	0 to 60 psi	08-I-105	Replace
LSH-32141	Ozone to R1 Liquid Separator 1 Level Switch High	L2	AMETEK Z-TRON III Z002-05 with 700-0206-201 Sensor	3/4" NPT	Setpoint	Insert Point	08-I-105	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
FE-32152 FIT-32152	R1 Sidestream Injector 2 Flowrate	F4	Electromagnetic Flowmeter E&H; PROMGAG 50 50PF- ER0A1AA0BAAA	Inline, 316SS, 6" ANSI 150 Flange	Range	0 to 1,000 gpm	08-I-105	Replace
PI-32142A	R1 Injector 2 Water Feed Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-105	Replace
PI-32142B	R1 Injector 2 Ozone Gas Pressure	P4	Ashcroft; Duragauge	1/2" NPT	Scale Range	0 to 30 psi	08-I-105	Replace
PE-32142C PI-32142C	R1 Injector 2 Ozonated Water Pressure	P4	Ashcroft; Duraflie	1/2" NPT	Scale Range	0 to 60 psi	08-I-105	Replace
LSH-32142	Ozone to R1 Liquid Separator 2 Level Switch High	L2	AMETEK Z-TRON III Z002-05 with 700-0206-201 Sensor	3/4" NPT	Setpoint	Insert point	08-I-105	Replace
AE-32011 AIT-32011	Ambient Oxygen Analyzer	A29	MSA A-UltimaX-E-14-E-1-S-03020001TC	Wall Mount	Range ALARM - High ALARM – High High	0 to 25% 22% (rising) 24.5% (rising)	08-I-106	Replace
AE-32021	Ambient Ozone Analyzer	A44	IN USA	Wall Mount	Cal.	0 to 1 ppm	08-I-	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
AIT-32021			IN-2000 L2-LC		Range Alarm Interlock	0.08 ppm (rising) 0.3 ppm	106	
PE-32521A PI-32521	Ozone to R5 Injector Pressure 1	P4	Ashcroft; Duralife	1/2" NPT	Scale Range Fluid fill	30 inHg V ac to 30 psi Glycerine	08-I-106	Replace
PE-32521B PSL-32521	Ozone to R5 Injector Pressure Switch Low 1	P8	Ashcroft; B420T XFMSNH076B	1/2" NPT	Setpoint	5 psi	08-I-106	Replace
PE-32522A PI-32522	OZONE TO R5 Injector Pressure 2	P4	Ashcroft; Duralife	1/2" NPT	Scale Range Fluid fill	30 inHg V ac to 30 psi Glycerine	08-I-106	Replace
PE-32522B PSL-32522	Ozone to R5 Injector Pressure Switch Low 2	P8	Ashcroft; B420T XFMSNH076B	1/2" NPT	Setpoint	5 psi	08-I-106	Replace
PI-32531A	R5 Injector Pump 1 Feed Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-106	Replace
PI-32531B	R5 Injector Pump 1 Discharge Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-106	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
PSL-32531B	R5 Injector Pump 1 Discharge Pressure Switch Low	P8	Ashcroft B420T XFMSNH076B	1/2" NPT	Range Setpoint	0 to 30 psi 12 psig (decreasing)	08-I-106	Replace
PI-32532A	R5 Injector Pump 2 Feed Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-106	Replace
PI-32532B	R5 Injector Pump 2 Discharge Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-106	Replace
PSL-32532B	R5 Injector Pump 2 Discharge Pressure Switch Low	P8	Ashcroft B420T XFMSNH076B	1/2" NPT	Range Setpoint	0 to 30 psi 12 psig (decreasing)	08-I-106	Replace
PI-32533A	R5 Injector Pump 3 Feed Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-106	Replace
PI-32533B	R5 Injector Pump 3 Discharge Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-106	Replace
PSL-32533B	R5 Injector Pump 3 Discharge Pressure Switch Low	P8	Ashcroft B420T XFMSNH076B	1/2" NPT	Range Setpoint	0 to 30 psi 12 psig (decreasing)	08-I-106	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
FE-32551 FIT-32551	R5 Sidestream Injector 1 Flowrate	F4	Electromagnetic Flowmeter E&H; PROMGAG 50 50PF- ER0A1AA0BAAA	Inline, 316SS, 6" ANSI 150 Flange	Range	0 to 1,000 gpm	08-I-106	Replace
PI-32541A	R5 Injector 1 Water Feed Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-106	Replace
PI-32541B	R5 Injector 1 Ozone Gas Pressure	P4	Ashcroft; Duragauge	1/2" NPT	Scale Range	0 to 30 psi	08-I-106	Replace
PE-32541C PI-32541C	R5 Injector 1 Ozonated Water Pressure	P4	Ashcroft; Duralife	1/2" NPT	Scale Range	0 to 60 psi	08-I-106	Replace
LSH-32541	R5 Ozone Liquid Separator 1 Level Switch High	L2	AMETEK Z-TRON III Z002-05 with 700-0206-201 Sensor	3/4" NPT	Setpoint	Insert point	08-I-106	Replace
FE-32552 FIT-32552	R5 Sidestream Injector 2 Flowrate	F4	Electromagnetic Flowmeter E&H; PROMGAG 50 50PF- ER0A1AA0BAAA	Inline, 316SS 6" ANSI 150 Flange	Range	0 to 1,000 gpm	08-I-106	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
PI-32542A	R5 Injector 2 Water Feed Pressure	P4	ASCROFT DURAGUGE 45-1279 SS 04L XNH	1/2" NPT	Scale Range	0 to 60 psi	08-I-106	Replace
PI-32542B	R5 Injector 2 Ozone Gas Pressure	P4	Ashcroft; Duragauge	1/2" NPT	Scale Range	0 to 30 psi	08-I-106	Replace
PE-32542C PI-32542C	R5 Injector 2 Ozonated Water Pressure	P4	Ashcroft; Duralife	1/2" NPT	Scale Range	0 to 60 psi	08-I-106	Replace
LSH-32542	R5 Ozone Liquid Separator 2 Level Switch High	L2	AMETEK Z-TRON III Z002-05 with 700-0206-201 Sensor	3/4" NPT	Setpoint	Insert Point	08-I-106	Replace
PDI-33511	Demister 1 Differential Pressure	P5	OZONIA	Demister has been removed	Scale Range	0 to 5.0 in H ₂ O	08-I-107	Replace
PDI-33512	Demister 2 Differential Pressure	P5	OZONIA	Demister has been removed	Scale Range	0 to 5.0 in H ₂ O	08-I-107	Replace
AE-33411 AIT-33411	Ambient Oxygen Analyzer	A29	MSA A-UltimaX-E-14-E-1-S-03020001TC	Wall Mount	Range ALARM - High ALARM – High High	0 to 25% 22%(rising) 24.5% (rising)	08-I-108	Replace
AE-33421	Ambient Ozone Analyzer	A44	IN USA	Wall Mount	Cal. Range	0 to 1 ppm 0.0 ppm	08-I-	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
AIT-33421			IN-2000 L2-LC		Alarm Interlock	(rising) 0.3 ppm	108	
LSH-33011	Off-Gas Destruction Drain Sump Level Switch High	L2					08-I-108	Replace
FE-26241 FIT-26241	Sodium Bisulfite Flow 1	F6	E&H 53H02-HC5B1RA0BAAJ	Process Connection: 1/2" Orifice: 1/12" Materials: 316SS tube, ceramic liner Electrodes: Platinum	Range	0 to 20.8 gph	08-I-110	Replace
PE-26231 PI-26231	Sodium Bisulfite Pressure 1	P6 P4	Ashcroft Duragauge c/w ONLY VALVE CO. Pattern # 5,708.201 process/seal connection	Bronze Tube Brass Socket Brazed	Range	0 to 60 psi	08-I-110	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
FE-26242 FIT-26242	Sodium Bisulfite Flow 2	F6	E&H 53H02-HC5B1RA0BAAJ	Process Connection: 1/2" Orifice: 1/12" Materials: 316SS tube, ceramic liner Electrodes: Platinum	Range	0 to 20.8 gph	08-I-110	Replace
PE-26232 PI-26232	SODIUM BISULFITE PRESSURE 2	P6 P4	Ashcroft Duragauge c/w ONLY VALVE CO. Pattern # 5,708.201 process/seal connection	Bronze Tube Brass Socket Brazed	Range	0 to 60 psi	08-I-110	Replace
AE-36121 AIT-36121	Sample Station 1 R1 Ozone Residual	A40	Rosemount Analytical Model 56		Range	0 to 10 mg/L	08-I-112	Replace
FE-36131A FIT-36131A	Sample Station 1 R1 Ozone Residual Flowmeter	F5		24V Loop powered; E+H Picomag IO-Link			08-I-112	New

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
AE-36521 AIT-36521	Sample Station 1 R5 Ozone Residual	A40	Rosemount Analytical Model 56	Probe Mounts in Flow-Thru Tee Use “VP” connection for probe	Range	0 to 10 mg/L	08-I- 112	Replace
FE-36531A FIT-36531A	Sample Station 1 R5 Ozone Residual Flowmeter	F5		24V dc Loop powered; E+H Picomag IO-Link			08-I- 112	New
DPSH- 36111	Sample Station 1 R1 Strainer Differential Pressure	P2		13207	Range Setpoint	0 to 20 psi 2 psi (rising)	08-I- 112	Demo
DPSH- 36511	Sample Station 1 R5 Strainer Differential Pressure	P2		13207	Range Setpoint	0 to 20 psi 2 psi (rising)	08-I- 112	Demo
FI-36131A	Sample Station 1 R1 Flow	F16			Range	0 to 5 gpm	08-I- 112	Demo
FI-36531A	Sample Station 1 R5 Flow	F16			Range	0 to 5 gpm	08-I- 112	Demo

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
AE-36122 AIT-36122	Sample Station 2 R1 Ozone Residual	A40	Rosemount Analytical; Model 56	Probe Mounts in Flow-Thru Tee Use “VP” connection for probe	Output Range	0 to 10 mg/L	08-I- 113	Replace
FE-36132A FIT-36132A	Sample Station 2 R1 Ozone Residual Flowmeter	F5		24VDC Loop powered; E+H Picomag IO-Link			08-I- 113	New
AE-36522 AIT-36522	Sample Station 2 R5 Ozone Residual	A40	Rosemount Analytical; Model 56	Probe Mounts in Flow-Thru Tee Use “VP” connection for probe	Output Range	0 to 10 mg/L	08-I- 113	Replace
FE-36532A FIT-36532A	Sample Station 2 R5 Ozone Residual Flowmeter	F5		24VDC Loop powered; E+H Picomag IO-Link			08-I- 113	New
DPSH- 36112	Sample Station 2 R1 Strainer Differential Pressure	P2		13207	Range Setpoint	0 to 20 psi 2 psi (rising)	08-I- 113	Demo

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
DPSH-36512	Sample Station 2 R5 Strainer Differential Pressure	P2		13207	Range Setpoint	0 to 20 psi 2 psi (rising)	08-I-113	Demo
FI-36132A	Sample Station 2 R1 Flow	F16			Range	0 to 5 gpm	08-I-113	Demo
FI-36532A	Sample Station 2 R5 Flow	F16			Range	0 to 5 gpm	08-I-113	Demo
AE-36123 AIT-36123	Sample Station 3 R1 Ozone Residual	A40	Rosemount Analytical; Model 56	Probe Mounts in Flow-Thru Tee Use "VP" connection for probe	Output Range	0 to 10 mg/L	08-I-114	Replace
FE-36133A FIT-36133A	Sample Station 3 R1 Ozone Residual Flowmeter	F5		24VDC Loop powered; E+H Picomag IO-Link			08-I-114	New
AE-36523 AIT-36523	Sample Station 3 R5 Ozone Residual	A40	Rosemount Analytical; Model 56	Probe Mounts in Flow-Thru Tee Use "VP" connection for probe	Output Range	0 to 10 mg/L	08-I-114	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
FE-36533A FIT-36533A	Sample Station 3 R5 Ozone Residual Flowmeter	F5		24VDC Loop powered; E+H Picomag IO-Link			08-I- 114	New
DPSH- 36113	Sample Station 3 R1 Strainer Differential Pressure	P2		13207	Range Setpoint	0 to 20 psi 2 psi (rising)	08-I- 114	Demo
DPSH- 36513	Sample Station 3 R5 Strainer Differential Pressure	P2		13207	Range Setpoint	0 to 20 psi 2 psi (rising)	08-I- 114	Demo
FI-36133A	Sample Station 3 R1 Flow	F16			Range	0 to 5 gpm	08-I- 114	Demo
FI-36533A	Sample Station 3 R5 Flow	F16			Range	0 to 5 gpm	08-I- 114	Demo
AE-36124 AIT-36124	Sample Station 4 R1 Ozone Residual	A40	Rosemount Analytical; Model 56	Probe Mounts in Flow-Thru Tee Use “VP” connection for probe	Output Range	0 to 10 mg/L	08-I- 115	Replace
FE-36134A FIT-36134A	Sample Station 4 R1 Ozone Residual Flowmeter	F5		24VDC Loop powered; E+H Picomag IO-Link			08-I- 115	New
AE-36524	Sample Station 4 R5	A40	Rosemount	Probe Mounts in	Output	0 to	08-I-	Replace

GRFF OZONE SYSTEM REPLACEMENT

Tag No.	Description	Comp Code	Existing Model No.	Installation Details	Options		P&ID	Status
AIT-36524	Ozone Residual		Analytical; Model 56	Flow-Thru Tee Use "VP" connection for probe	Range	10 mg/L	115	
FE-36534A FIT-36534A	Sample Station 4 R5 Ozone Residual Flowmeter	F5		24VDC Loop powered; E+H Picomag IO-Link			08-I- 115	New
DPSH- 36114	Sample Station 4 R1 Strainer Differential Pressure	P2		13207	Range Setpoint	0 to 20 psi 2 psi (rising)	08-I- 115	Demo
DPSH- 36514	Sample Station 4 R5 Strainer Differential Pressure	P2		13207	Range Setpoint	0 to 20 psi 2 psi (rising)	08-I- 115	Demo
FI-36134A	Sample Station 4 R1 Flow	F16			Range	0 to 5 gpm	08-I- 115	Demo
FI-36534A	Sample Station 4 R5 Flow	F16			Range	0 to 5 gpm	08-I- 115	Demo
Installation Detail Notes: 1. 3-Valve manifold required.								

SECTION 44 42 56.02
HORIZONTAL END-SUCTION CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Bearing Manufacturers' Association (ABMA).
 2. Hydraulic Institute (HI) Standards:
 - a. 9.6.4, Rotodynamic Pumps for Vibration Measurements and Allowable Values.
 - b. 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.
 3. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.
 4. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components - Lead Content.

1.02 DEFINITIONS

- A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.03 SUBMITTALS

- A. Action Submittals:
1. Data sheets for motive water pumps, including manufacturer's catalog information, materials of construction, pump curve, motor horsepower, and pump efficiency.
 2. Power and control wiring diagrams, including terminals and numbers.
 3. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications.
 4. Factory finish system.
 5. Field Performance Test Certificates.
 6. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

GRFF OZONE SYSTEM REPLACEMENT

B. Informational Submittals:

1. Manufacturer's installation instructions.
2. Special shipping, unloading, storage, handling and protection instructions.
3. Detailed schedule for OSS field services through final completion of the Project.
4. Manufacturer's Certification of Compliance that the factory finish system is identical to the requirements specified herein.
5. Manufacturer's Certificate of Proper Installation.
6. Manufacturer's warranty.
7. Source Quality Control and Factory Test Results, Reports, and Certificates.
8. Field Functional Test Certificates.

1.04 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

1. Complete set of gaskets and O-ring seals.
2. Complete mechanical seal, if used.
3. Complete set of pump bearings.
4. Casing and impeller wear rings, if used.

B. Contain spare parts in suitable boxes clearly marked as to content.

PART 2 PRODUCTS

2.01 GENERAL

- A. The motive water pumps, cooling water pumps, and generator coolant pumps shall be replaced. The existing piping, valves, and injectors shall remain in service.
- B. Coordinate pump requirements with drive manufacturer and be responsible for pump and drive requirements.
- C. Furnish a coordinated operating system complete with pump and motor.
- D. Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with NSF/ANSI 61 and NSF/ANSI 372 and are free of lead.

2.02 SYSTEM DESCRIPTION

- A. The capacity of the ozone injection system shall be as specified in PART 3 – Veolia Power Supply Unit Procurement Proposal and Control Panel Procurement Proposal, Section 44 44 56, Ozone System—General.
- B. Six ozone injection pump and motor assemblies shall be provided.
- C. Three cooling water (open loop) pump and motor assemblies shall be provided.
- D. Two generator coolant water (closed loop) pump and motor assemblies shall be provided.
- E. The pump skids shall fit in the available space as shown on the Drawings. Connections to the existing piping shall require only minimal piping modifications that can be accommodated within the existing space. See the Drawings for suction and discharge pipe sizing.

2.03 PERFORMANCE REQUIREMENTS AND EQUIPMENT DESCRIPTION

- A. General:
 - 1. Performance Curves: All centrifugal pumps shall have a continuously rising curve or the system operating range shall not cross the pump curve at two different capacities or “dip region.” The required pump shaft horsepower at any point on the performance curve shall not exceed the rated horsepower of the motor or encroach on the service factor.
 - 2. Factory Finishing: Prepare, prime, and finish coat per manufacture’s standard.
 - 3. Drive: Direct drive with flexible coupling with heavy-duty, horizontal, electric motor suitable for 460-volt, three-phase, 60-Hz power supply.
 - 4. Pressure Indication: Suction and discharge pressure gauges on each pump with ranges to accommodate maximum pressure values but accurately display low pressure values.
- B. Ozone Injection Pumps:
 - 1. The sidestream injection pump system shall integrate with the existing system to provide dynamic small bubble gas-liquid mixing at the side stream injector and within the main pipeline flow.
 - 2. Motive Water Pumps: There shall be six motive water pumps, each sized to provide the necessary flow and pressure to four injectors operating at its maximum gas flow requirements. Pumps shall be constant speed, end suction type centrifugal pumps with 1.15 service

GRFF OZONE SYSTEM REPLACEMENT

factor, high efficiency TEFC motors, and meet the requirements for horizontal end suction pumps specified below.

- a. Operating Conditions:
 - 1) The sidestream injection pumps shall be suitable for long-term operation under the following conditions:
 - a) Duty: Continuous.
 - b) Drive: Constant speed.
 - c) Ambient Environment: Indoors, non air-conditioned.
 - d) Ambient Temperature Range, Degrees F: 50 to 110.
 - e) Fluid Service: Water.
 - f) Fluid Temperature Range, Degrees F: 33 to 78.
 - g) Fluid pH Range: 7.0 to 8.8.
 - h) Minimum Available NPSH, Feet: 40.
- b. Performance Requirements:
 - 1) Maximum Shutoff Head, Feet: 180.
 - 2) Design Flow Capacity, gpm: 680.
 - 3) Design Flow Pump Head, TDH Feet: 120.
 - 4) Pump Suction Pressure, Feet: 3.
 - 5) Design Flow Minimum Pump Efficiency, Percent: 80.
 - 6) Maximum Pump Speed, rpm: 1,750.
 - 7) Maximum Motor Speed, rpm: 1,800.
 - 8) Motor Size, hp: 25.
- c. Construction:
 - 1) Construction of horizontal end-suction pumps shall conform to the following requirements:
 - a) Casing, Foot-Mounted: Ductile iron, ASTM A395, back pullout design with gauge connections.
 - b) Pump Base: Ductile iron or steel base plate with drain rim or pan, epoxy coated.
 - c) Impeller: Type 316 stainless steel, statically and dynamically balanced, open.
- d. All components of each pump system provided under the pump sections shall be entirely compatible. Each unit of pumping equipment shall incorporate all basic mechanisms, couplings, electric motors drives, necessary mountings, and appurtenances.
 - 1) Case Wear Rings: Type 316 stainless steel.
 - 2) Shaft: Type 316 stainless steel, designed for maximum 0.002-inch deflection at sealing face at maximum load.
 - 3) Shaft Sleeve: Type 316 stainless steel.
 - 4) Seal: Single, mechanical split-type seal.
 - 5) Coupling: Flexible heavy-duty spacer shaft coupling with guard.
 - 6) Mounting: Frame mounted.

- 7) Bearings: Double row thrust bearing outboard, and single row radial bearing inboard.
- 8) Lubrication: Grease, with inlet and drain fittings.

C. Cooling Water Pumps (Open Loop / Heat Rejection):

1. The open loop cooling water pump shall integrate with the existing system to provide heat rejection for the closed loop ozone generator coolant system.
2. Cooling Water Pumps: There shall be three open loop cooling water pumps, each sized to provide the necessary flow and pressure to the automatic cleaning basket strainers and ozone generator heat exchanger. Pumps shall be constant speed, end suction type centrifugal pumps with 1.15 service factor, high efficiency TEFC motors, and meet the requirements for horizontal end suction pumps specified below.
 - a. Operating Conditions:
 - 1) The cooling water pumps shall be suitable for long-term operation under the following conditions:
 - a) Duty: Continuous.
 - b) Drive: Constant speed.
 - c) Ambient Environment: Indoors, non air-conditioned.
 - d) Ambient Temperature Range, Degrees F: 50 to 110.
 - e) Fluid Service: Water.
 - f) Fluid Temperature Range, Degrees F: 40 to 78.
 - g) Fluid pH Range: 7.0 to 8.8.
 - h) Minimum Available NPSH, Feet: 1.0.
 - b. Performance Requirements:
 - 1) Maximum Shutoff Head, Feet: 195.
 - 2) Design Flow Capacity, gpm: 215.
 - 3) Design Flow Pump Head, TDH Feet: 130.
 - 4) Pump Suction Pressure, Feet: 3.
 - 5) Design Flow Minimum Pump Efficiency, Percent: 80.
 - 6) Maximum Pump Speed, rpm: 1,750.
 - 7) Maximum Motor Speed, rpm: 1,800.
 - 8) Motor Size, hp: 15.
 - c. Construction:
 - 1) Construction of horizontal end-suction pumps shall conform to the following requirements:
 - a) Casing, Foot-Mounted: Ductile iron, ASTM A395, back pullout design with gauge connections.
 - b) Pump Base: Ductile iron or steel base plate with drain rim or pan, epoxy coated.
 - c) Impeller: Type 316 stainless steel, statically and dynamically balanced, open.

GRFF OZONE SYSTEM REPLACEMENT

D. Generator Coolant Water Pumps (Closed Loop):

1. The closed loop generator coolant water pump shall integrate with the existing system to remove heat from the ozone generator and power supply unit.
2. Coolant Water Pumps: There shall be two closed loop cooling water pumps, each sized to provide the necessary flow and pressure ozone generator shell, power supply unit, and heat exchanger. Pumps shall be constant speed, end suction type centrifugal pumps with 1.15 service factor, high efficiency TEFC motors, and meet the requirements for horizontal end suction pumps specified below.
 - a. Operating Conditions:
 - 1) The generator coolant pumps shall be suitable for long-term operation under the following conditions:
 - a) Duty: Continuous.
 - b) Drive: Constant speed.
 - c) Ambient Environment: Indoors, non air-conditioned.
 - d) Ambient Temperature Range, Degrees F: 50 to 110.
 - e) Fluid Service: Deionized Water.
 - f) Fluid Temperature Range, Degrees F: 65 to 92.
 - g) Fluid pH Range: 7.0.
 - h) Minimum Available NPSH, Feet: 1.0.
 - b. Performance Requirements:
 - 1) Maximum Shutoff Head, Feet: 82.5.
 - 2) Design Flow Capacity, gpm: 205.
 - 3) Design Flow Pump Head, TDH Feet: 55.
 - 4) Pump Suction Pressure, Feet: 4.
 - 5) Design Flow Minimum Pump Efficiency, Percent: 80.
 - 6) Maximum Pump Speed, rpm: 1,750.
 - 7) Maximum Motor Speed, rpm: 1,800.
 - 8) Motor Size, hp: 7.5.
 - c. Construction:
 - 1) Construction of horizontal end-suction pumps shall conform to the following requirements:
 - a) Casing, Foot-Mounted: Ductile iron, ASTM A395, back pullout design with gauge connections.
 - b) Pump Base: Ductile iron or steel base plate with drain rim or pan, epoxy coated.
 - c) Impeller: Type 316 stainless steel, statically and dynamically balanced, open.

- E. Instrumentation: Other instrumentation needs for pump assemblies shall be as shown on the P&IDs and as shown in PART 3 – Veolia Power Supply Unit Procurement Proposal and Control Panel Procurement Proposal, Section 44 44 56.10, Ozone System Instruments.

2.04 ACCESSORIES

- A. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in a readily visible location.
- B. Lifting Lugs: Equipment weighing over 100 pounds.
- C. OSHA-approved coupling guard for direct coupled or belt driven pumps.
- D. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer.

2.05 FACTORY FINISHING

- A. Manufacturer's standard enamel finish.

2.06 SOURCE QUALITY CONTROL

- A. Factory Test Report: Include test data sheets, and curve test results, certified correct by a registered Professional Engineer.
- B. Functional Test:
 - 1. Perform manufacturer's standard, test on equipment. Include vibration test, as follows:
 - a. Dynamically balance rotating parts of each pump and its driving unit before final assembly.
- C. Performance Test:
 - 1. In accordance with Hydraulic Institute Standards.
 - 2. Adjust, realign, or modify units and retest in accordance with Hydraulic Institute Standards if necessary.
- D. Hydrostatic Tests: Pump casing(s) tested at 150 percent of shutoff head. Test pressure maintained for not less than 5 minutes.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Contractor shall install in accordance with the Supplier's recommendations. Mount equipment skids, if applicable, on flat and level concrete bases. Existing concrete bases shall be modified or demolished and replaced as needed for a coordinated installation.
- B. Adjust equipment assemblies such that the driving units are properly aligned, plumb, and level with the driven units and all interconnecting shafts and

GRFF OZONE SYSTEM REPLACEMENT

couplings. Flexible couplings shall not be considered to compensate for misalignment.

- C. All strain from attached piping shall be eliminated and any evidence of misalignment, vibration, noisy operation, or other signs of improper setting shall be corrected by the Contractor. Care during storage, installation, and lubrication shall be in strict accordance with the Supplier's recommendations. Pipe all equipment drains to hub drains.
- D. Contractor shall make field connections between junction boxes and control panels as recommended by the Supplier.
- E. Contractor shall provide the necessary oil and grease for initial operation.

3.02 INSPECTION AND TESTING

- A. General: Prior to plant startup, all equipment shall be inspected for proper alignment, operational noise levels, proper connection, and satisfactory performance.
- B. Ozone Injection Pumps:
 - 1. Functional field performance testing of the sidestream injection system, utilizing GOX without ozone being generated, shall be conducted prior to treatment plant process facilities startup. The purpose of the test will be to verify that the sidestream injection system is capable of handling the range of gas flows corresponding to the ozone production range as specified in PART 3 – Veolia Power Supply Unit Procurement Proposal and Control Panel Procurement Proposal, Section 44 42 56, Ozone System—General. Functional testing shall demonstrate startup/shutdown of motive water pumps, and corresponding sidestream piping and ozone gas piping assemblies as plant flow varies and as gas flow varies.
 - 2. Performance Testing:
 - a. To demonstrate compliance with Performance Requirements, the sidestream injection system shall be operated and tested for compliance under at least the following conditions:
 - 1) Maximum gas flow rate and ozone production for two ozone contactors.
 - 2) Sidestream injection system testing may be conducted in conjunction with the minimum and maximum ozone production testing.
 - 3) Test data shall include as a minimum:
 - a) Measured ozone feed gas flow and concentration.
 - b) Measured ozone contactor off-gas pressure, temperature, and ozone concentration.

C. Cooling Water Pumps:

1. Functional field performance testing of the open and closed loop cooling water pump utilizing water, shall be conducted prior to treatment plant process facilities startup. The purpose of the test will be to verify that the cooling water system is capable of flowrates corresponding to the flowrates specified in PART 3 – Veolia Power Supply Unit Procurement Proposal and Control Panel Procurement Proposal, Section 44 44 56, Ozone System—General. Functional testing shall demonstrate startup/shutdown of cooling water pumps.
2. Performance Testing:
 - a. To demonstrate compliance with Performance Requirements, the cooling water system shall be operated and tested for compliance under at least the following conditions:
 - 1) Maximum flow rate and discharge pressure.
 - 2) Test data shall include as a minimum:
 - a) Measured flowrate.
 - b) Measured suction and discharge pressure.

3.03 MANUFACTURER’S SERVICES

- A. See Section 01 43 33, Manufacturers’ Field Services.

3.04 SUPPLEMENTS

- A. The supplements listed below, following “End of Section,” are a part of this specification:
1. Ozone Injection Pump Data Sheet.
 2. Open Loop Cooling Water Pump Data Sheet.
 3. Closed Loop Coolant Water Pump Data Sheet.

END OF SECTION

OZONE INJECTION PUMP DATA SHEET

Tag Numbers: PMP-32131, PMP-32132, PMP-32133, PMP-32531, PMP-32532, PMP-32533

Pump Name: Reactor 1 Injector Pumps 1-3, and Reactor 5 Injector Pumps 1-3

Manufacturer and Model Number: (1) Pentair Aurora Pumps, 344A 5 x 6 x 11

(2) Flowserve Worthington, Mark 3 2K6 x 4

(3) Peerless Pumps, C740

(4) "Or-equal"

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): Clean Water

Pumping Temperature (Fahrenheit): Normal: 50 Max 78 Min 34

Specific Gravity at 60 Degrees F: 1.0

pH: 7.5

Abrasive (Y/N): N Possible Scale Buildup (Y/N): N

Min. NPSH Available (Ft. Absolute): 34

Altitude (Feet above Mean Sea Level): 900 feet

Area Classification: Indoor, Non-Hazardous Industrial

Ambient Temperature (degrees F.): 30-110

Location: Indoor (Y/N): Y Outdoor (Y/N): N

PERFORMANCE REQUIREMENTS

Capacity (US gpm): Rated: 815

Total Dynamic Head (Ft): Rated: 90

Min. Pump Hydraulic Efficiency at Rated Capacity (%): 75

Max. Pump Speed at Rated Capacity (rpm): 1,750

Constant (Y/N): Y

GRFF OZONE SYSTEM REPLACEMENT

DESIGN AND MATERIALS

Pump Type: Horizontal (Y/N) Y Frame-Mounted (Y/N) _____

Vertical (Y/N) _____ Other _____

Casing Material: Cast Iron

Casing Wear Rings (Y/N) Y Casing Wear Ring Material: ASTM B62 Bronze

Impeller: Material: ASTM B584 Bronze

Impeller Wear Rings (Y/N) Y Impeller Wear Ring Material: Bronze

Shaft Material: Steel AISI C1045 Shaft Sleeve Material: ASTM B62 Bronze

Shaft Seal: Packing (Y/N) _____ Mechanical (Y/N) Y Type: _____

Seal Lubrication: Pumping fluid

Coupling: Manufacturer Standard (Y/N) Y

Baseplate Material: Cast Iron

Drive Type: Direct-Coupled x Belt _____ Adjustable Speed _____ Other _____

DRIVE MOTOR

Horsepower: 25 Voltage: 460 Phase: 3

Service Factor: 1.15

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC X
CISD-TEFC _____ TENV _____ WPI _____ WPII _____ SUBM _____

Mounting Type: Horizontal X Vertical Solid Shaft _____

Nonreverse Ratchet (Y/N) Y

REMARKS _____

OPEN LOOP COOLING WATER PUMP DATA SHEETTag Numbers: PMP-31311, PMP-31312, PMP-31313Pump Name: Open Loop Cooling Water Pumps 1-3Manufacturer and Model Number: (1) Grundfos, CR-45-2-2(2) Pentair Aurora Pumps, 382A 3 x 3 x 9(3) Peerless Pumps, C1215(4) "Or-equal"

“

SERVICE CONDITIONSLiquid Pumped (Material and Percent): Clean WaterPumping Temperature (Fahrenheit): Normal: 50 Max 78 Min 34pH: 7.4Abrasive (Y/N) N Possible Scale Buildup (Y/N): NMin. NPSH Available (Ft. Absolute): 34Altitude (Feet above Mean Sea Level): 900Area Classification: Indoor, Non-Hazardous IndustrialAmbient Temperature (degrees F.): 32-110Location: Indoor (Y/N): Y Outdoor (Y/N): N**PERFORMANCE REQUIREMENTS**Capacity (US gpm): Rated: 215Total Dynamic Head (Ft): Rated: 140Min. Pump Hydraulic Efficiency at Rated Capacity (%): 75Max. Pump Speed at Rated Capacity (rpm): 1,750Constant (Y/N): Y

GRFF OZONE SYSTEM REPLACEMENT

DESIGN AND MATERIALS

Pump Type: Horizontal (Y/N) _____ Frame-Mounted (Y/N) _____

Vertical (Y/N) Y _____ Other _____

Casing Material: Cast Iron _____

Impeller: Material: Stainless Steel AISI 304 _____

Shaft Material: Stainless Steel AISI 431 _____

Shaft Sleeve Material: Stainless Steel AISI 304 _____

Shaft Seal: Packing (Y/N) Y _____ Mechanical (Y/N) Y _____ Type: Cartridge _____

Coupling: Manufacturer Standard (Y/N) Y _____

Baseplate Material: Cast Iron _____

Drive Type: Direct-Coupled X _____ Belt _____ Adjustable Speed _____ Other _____

DRIVE MOTOR

Horsepower: 10 _____ Voltage: 480 _____ Phase: 3 _____

Service Factor: 1.15 _____

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC X _____ CISD-TEFC _____
TENV _____ WPI _____ WPII _____ SUBM _____

Mounting Type: Horizontal _____ Vertical Solid Shaft _____

Nonreverse Ratchet (Y/N) Y _____

REMARKS _____

CLOSED LOOP COOLANT WATER PUMP DATA SHEETTag Numbers: PMP-31411, PMP-31412Pump Name: Ozone Generator Coolant Water Pumps 1-2Manufacturer and Model Number: (1) Pentair Aurora Pumps, 344A 2-1/2 x 3 x 9(2) Flowserve Worthington, Mark 3 2K3 x 2(3) Peerless Pumps, C620A(4) "Or-equal"**SERVICE CONDITIONS**Liquid Pumped (Material and Percent): Deionized WaterPumping Temperature (Fahrenheit): Normal: 85 Max 92 Min 70pH: 7.0Abrasive (Y/N) N Possible Scale Buildup (Y/N): NAltitude (Feet above Mean Sea Level): 920 feetArea Classification: Indoor, Non-Hazardous IndustrialAmbient Temperature (degrees F.): 32-110Location: Indoor (Y/N): Y Outdoor (Y/N): N**PERFORMANCE REQUIREMENTS**Capacity (US gpm): Rated: 205Total Dynamic Head (Ft): Rated: 55Min. Pump Hydraulic Efficiency at Rated Capacity (%): 65Max. Pump Speed at Rated Capacity (rpm): 1750Constant (Y/N): YAdjustable (Y/N): N

GRFF OZONE SYSTEM REPLACEMENT

DESIGN AND MATERIALS

Pump Type: Horizontal (Y/N) Y Frame-Mounted (Y/N) _____

Vertical (Y/N) _____ Other _____

Casing Material: Cast Iron

Casing Wear Rings (Y/N) Y Casing Wear Ring Material: ASTM B62 Bronze

Impeller: Material: ASTM B584 Bronze

Impeller Wear Rings (Y/N) Y Impeller Wear Ring Material: Bronze

Shaft Material: Steel AISI C1045 Shaft Sleeve Material: ASTM B62 Bronze

Shaft Seal: Packing (Y/N) _____ Mechanical (Y/N) Y Type: Cartridge

Seal Lubrication: Pumping fluid

Coupling: Manufacturer Standard (Y/N) Y

Baseplate Material: Cast Iron

Drive Type: Direct-Coupled X Belt _____ Adjustable Speed _____ Other _____

DRIVE MOTOR

Horsepower: 7.5 Voltage: 460 Phase: 3

Service Factor: 1.15

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC X CISD-TEFC _____
TENV _____ WPI _____ WPII _____ SUBM _____

Mounting Type: Horizontal X Vertical Solid Shaft _____

Nonreverse Ratchet (Y/N) Y

REMARKS _____

SECTION 44 42 56.17
SAMPLING PUMPS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Bearing Manufacturers' Association (ABMA).
2. Hydraulic Institute Standards (HIS).
3. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.
4. UL.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Make, model, weight, and horsepower of each equipment assembly.
 - b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
 - c. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity.
 - d. Pump equipment cutsheet showing the equipment dimensions, size, and locations of connections and weights of associated equipment.
 - e. Power and control wiring diagrams, including terminals and numbers.
 - f. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications.
 - g. Factory finish system.
 - h. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's printed installation instructions.

GRFF OZONE SYSTEM REPLACEMENT

3. Suggested spare parts list to maintain the equipment in service for a period of 1 year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
4. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
5. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

PART 2 PRODUCTS

2.01 GENERAL

- A. Coordinate pump requirements with drive manufacturer and be responsible for pump and drive requirements.

2.02 ACCESSORIES

- A. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in a readily visible location.
- B. Lifting Lugs: Equipment weighing over 100 pounds.
- C. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer.

2.03 FACTORY FINISHING

- A. Manufacturer's standard enamel finish.

2.04 SOURCE QUALITY CONTROL

- A. Performance Test:
 1. Conduct on each pump.
 2. Perform under simulated operating conditions.
 3. Test for a continuous 1 period without malfunction.
 4. Test Log: Record the following:
 - a. Capacity.
 - b. Flow measured by factory instrumentation and storage volumes.
 - c. Pump discharge pressure converted to feet of liquid pumped and corrected to pump discharge centerline.
 5. Adjust, realign, or modify units and retest if necessary.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Contractor shall install in accordance with the Supplier's recommendations. Mount equipment skids, if applicable, on flat and level surface.
- B. Adjust equipment assemblies such that the driving units are properly aligned, plumb, and level with the driven units and all interconnecting shafts and couplings. Flexible couplings shall not be considered to compensate for misalignment.
- C. All strain from attached piping shall be eliminated and any evidence of misalignment, vibration, noisy operation, or other signs of improper setting shall be corrected by the Contractor. Care during storage, installation, and lubrication shall be in strict accordance with the Supplier's recommendations. Pipe all equipment drains to hub drains.
- D. Contractor shall make field connections between junction boxes and control panels as recommended by the Supplier.

3.02 FIELD QUALITY CONTROL

- A. Conduct tests on each pump.
- B. Functional Tests:
 - 1. Conduct on each pump.
 - 2. Perform under simulated operating conditions.
 - 3. Test for a continuous 1-hour period without malfunction.
 - 4. Test Log: Record the following:
 - a. Capacity.
 - b. Flow measured by factory instrumentation and storage volumes.
 - c. Pump discharge pressure converted to feet of liquid pumped and corrected to pump discharge centerline.
 - 5. Adjust, realign, or modify units and retest if necessary.
- C. In accordance with Hydraulic Institute Standards.

3.03 SUPPLEMENT

- A. The supplement listed below, following "End of Section," is a part of this specification:
 - 1. Sampling Pump Data Sheet.

END OF SECTION

SAMPLING PUMP DATA SHEET

Tag Numbers: PMP-36101, PMP-36102, PMP-36103, PMP-36104, PMP-36501, PMP-36502, PMP-36503, PMP-36504

Pump Name: Reactor 1 Sample Station 1-4 Pumps and Reactor 5 Sample Station 1-4 Pumps

Manufacturer and Model Number: (1) Grundfos CRN 1-3
(2) "Or-equal" "
(3) _____

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): Ozonated Water

Pumping Temperature (Fahrenheit): Normal: 65 Max 78 Min 32

pH: 6-8

Abrasive (Y/N): N Possible Scale Buildup (Y/N): N

Inlet Pressure at Pump (psig): 1.75

Min. Net Positive Inlet Pressure Available (psia): _____

PERFORMANCE REQUIREMENTS

Rated Capacity: 10 US gpm at 25 psi differential pressure.

Max. Pump Speed (rpm): _____ Constant (Y/N): Y Adjustable (Y/N): N

Speed Range: _____% to _____% of Rated Speed: _____ Constant Torque (Y/N): _____

DESIGN AND MATERIALS

Pump Body Material: Stainless Steel Drive Housing Material: Cast Iron

Pump Stages: Manufacturer Selection

Connections:

Suction: Flanged: X Flange Type: ASME/ANSI 250 class

Discharge: Flanged: X Flange Type: ASME/ANSI 250 class

Bearing: Silicon Carbide Shaft Ring

Shaft Sleeve (Y/N): Y Material: Stainless Steel; O-Ring for Sleeve: EPDM

GRFF OZONE SYSTEM REPLACEMENT

Shaft Seal: Cartridge, balanced seal Type: Double seal, back to back
Material, Seal Face: Silicon Carbide

ABMA B-10 Bearing Life (hrs): _____ Lubrication: _____

Coupling: Manufacturer Standard (Y/N): Y
Baseplate: Material: Cast Iron

Drive Type: Direct-Coupled: X

DRIVE MOTOR

Horsepower: 0.75 Voltage: 480 Phase: 3 Base Speed (rpm): 3,500

Service Factor: 1.15 Inverter Duty (Y/N) _____

Motor nameplate horsepower shall not be exceeded at any head-capacity point on the pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC X CISD-TEFC _____
TENV _____ WPI _____ WPII _____ SUBM _____

Drive Arrangement: In-Line: x
Nonreverse Ratchet (Y/N): Y

REMARKS _____

SECTION 44 44 13.01
CHEMICAL METERING PUMPS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. Hydraulic Institute Standards.
 2. Institute of Electrical and Electronics Engineers (IEEE): 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
 3. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.

1.02 DEFINITIONS

- A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.03 SUBMITTALS

- A. Action Submittals:
1. Shop Drawings:
 - a. Make, model, weight, and horsepower of each equipment assembly.
 - b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
 - c. Performance data on pumps, including curves showing flow rate verses pump stroke setting (in percent) at specified maximum speed in strokes per minute and at minimum pump speed.
 - d. Pump data sheet confirming pump capacity in gallons per hour and pressure in pounds per square inch gauge, required backpressure valve setting, pumped chemical characteristics, pipe connection sizes, stroke rate, materials, testing requirements, intermediate fluid type, and appurtenances to be provided with pumps.
 - e. Detailed Dimensional Drawings for pump and driver, including mounting requirements and piping connection sizes and locations.
 - f. Power and control wiring diagrams, including terminals and numbers.
 - g. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications.

GRFF OZONE SYSTEM REPLACEMENT

- h. Manufacturer's materials compatibility information, confirming compatibility of wetted parts with specified pumped chemicals.
- i. Factory finish system.
- j. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

- 1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
- 2. Special shipping, storage and protection, and handling instructions.
- 3. Manufacturer's printed installation instructions.
- 4. Suggested spare parts list to maintain the equipment in service for a period of 1-year and 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
- 5. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
- 6. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
- 7. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

PART 2 PRODUCTS

2.01 GENERAL

- A. Coordinate pump requirements with drive manufacturer and be responsible for pump and drive requirements.
- B. Where adjustable speed drives are required, furnish a coordinated operating system complete with pump, drive, and speed controller.

2.02 PUMP

- A. Pump shall be simplex, motor-driven, reciprocating, mechanically-actuated diaphragm type.
- B. Diaphragm shall be compression-molded Teflon or compression-molded Teflon composite with internal O-ring seal. Diaphragm shall be nylon fabric-reinforced EPDM vulcanized onto a steel core, with Teflon facing on liquid contact side of diaphragm with dual sealing ribs. Diaphragm shall be convex in shape, coordinated with concave head to minimize dead space.

- C. Bearings, tapered roller or needle type. Gearing, polished steel worm type. Mount bearings and internal working parts in weather-resistant gear box with moving parts oil flooded.
- D. Lubricant, nontoxic food grade quality.
- E. Pump shall include adjustable, spring-loaded internal pressure relief valve to protect pump against excessive hydraulic pressure.

2.03 PULSATION DAMPENERS

- A. Single-diaphragm type mounted on discharge piping as shown on the P&ID Drawings. Size for pump stroke volume. Body material shall be PVC and diaphragm material shall be PTFE.
- B. Include air charging valve and pressure gauge.

2.04 VALVES

- A. Adjustable diaphragm backpressure sustaining type installed on pump discharge as shown on the Drawings and set as recommended by pump manufacturer.
- B. Adjust existing pressure relief valve installed on pump discharge as shown on the Drawings and set as recommended by pump manufacturer.

2.05 PUMP OUTPUT CONTROL

- A. Manual Stroke Adjustment: Provide manual stroke length adjustment through adjustment knob on unit that provides adjustment accuracy of 1 percent. Adjustment shall be self-locking, and shall be operable whether or not pump is running.
- B. Adjustable Speed (Stroke Frequency) Adjustment: Provide adjustable speed operation of pump using AC inverter. Coordinate pump motor type with drive unit provided. AC inverter shall be in accordance with Section 26 29 23, Variable-Frequency Drives. Drive unit shall include integral or separate control panel with speed indication in percent, HAND/OFF/AUTO selector switch, and manual adjustable potentiometer for adjustment of pump speed when in HAND position. Drive shall accept external Profibus control signal to provide linear adjustment of pump speed from zero to 100 percent when in AUTO position. Provide DRIVE FAIL and ON/OFF discrete output signals. Provide 4 mA to 20 mA analog output signal for drive speed.

GRFF OZONE SYSTEM REPLACEMENT

2.06 ACCESSORIES

- A. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in a readily visible location.
- B. Lifting Lugs: Equipment weighing over 100 pounds.
- C. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer.
- D. Gauge Connections: Tapped and plugged suction and discharge gauge connections on piping headers adjacent to pumps.
- E. Screens or Guards: Mesh size of less than 0.5-inch, exposed rotating shafts, rotors, couplings, pulley, wheel, bolts, chains, or similar components. Where guards/screens are over grease fittings, couplings, or other items requiring maintenance, provide a means for ready access.

2.07 FACTORY FINISHING

- A. Manufacturer's standard finish.

2.08 SOURCE QUALITY CONTROL

- A. Functional Test: Perform manufacturer's standard, motor test on equipment.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.
- B. Anchor Bolts: Accurately place using equipment templates and as specified in Section 01 88 15, Anchorage and Bracing.

3.02 FIELD QUALITY CONTROL

- A. Conduct tests on each pump.
- B. Functional Test:
 - 1. Alignment: Test complete assemblies for proper alignment and connection, and quiet operation.
- C. Performance Test:
 - 1. Perform under actual or approved simulated operating conditions.
 - 2. Test for a continuous 1-hour period without malfunction.

3.03 MANUFACTURER'S SERVICES

A. Manufacturer's Representative:

1. Present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:
 - a. 1/2 person-day for inspection.
 - b. 1/2 person-day for performance testing and completion of Manufacturer's Certificate of Proper Installation.

B. See Section 01 43 33, Manufacturers' Field Services.

3.04 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this specification:

1. Sodium Bisulfite Feed Pumps 1 – 4 Data Sheet.

END OF SECTION

CHEMICAL METERING PUMP DATA SHEETTag Numbers: PMP-26221, PMP-26222, PMP-26223, and PMP-26224Pump Name: Sodium Bisulfite Feed Pumps 1 - 4Manufacturer and Model Number: (1) Lutz Jesco MEMDOS LB60 56C
(2) _____**SERVICE CONDITIONS**Liquid Pumped (Material and Percent): 38% Sodium BisulfitePumping Temperature (Fahrenheit): Normal: 75 Max: 100 Min: 32Liquid pH: 4.0 – 5.2Abrasive (Y/N) _____ Possible Scale Buildup (Y/N): NSuction Pressure (psig): Minimum 0Altitude (ft msl): 900 Area Classification: Non-Hazardous IndustrialLocation (indoor/outdoor): Indoor**PERFORMANCE REQUIREMENTS**Capacity (US gph): Maximum: 20 Minimum: 5Maximum Discharge Pressure (psig): 70Internal Bypass Valve Setting (psig): 90Relief Valve Setting (psig/as recommended): Manufacturer recommendationBack Pressure Valve Setting (psig/as recommended): Manufacturer recommendationMax. Stroke Rate (spm): Mfr. (1) 144**DESIGN AND MATERIALS**Pump Type: Single Diaphragm (Y/N) Y

Tubular (double) Diaphragm (Y/N) _____ Other _____

Wet End Material: PVDF or PTFECheck Valve Material: PVCDiaphragm Material: PVDF or PTFEDiaphragm Actuation Type: Mechanical X Hydraulic _____Stroke Position Adjustment: Manual X Automatic _____Pump Speed Control: Constant _____ Variable X

GRFF OZONE SYSTEM REPLACEMENT

DRIVE MOTOR

Horsepower: 0.33 Voltage: 480 Phase: 3

Service Factor: 1.15

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Adjustable Speed Drive, See Section 26 29 23, Variable-Frequency Drives.

TESTING

Pump Tests: Factory Functional (Y/N) _____ Factory Performance (Y/N) Y

Field Functional (Y/N) Y Field Performance (Y/N) Y

REMARKS

**SECTION 44 44 56.03
NITROGEN BOOST SKID**

PART 1 GENERAL

1.01 GENERAL

- A. The Contractor shall furnish replacement equipment for the nitrogen boost skid to provide a side stream of air to the ozonation system equipment. The Contractor shall be responsible for furnishing of the nitrogen boost system equipment, following the requirements of these Specifications.

1.02 EQUIPMENT NUMBERS

- A. Compressors:
 - 1. CMP-31511.
 - 2. CMP-31512.
- B. Desiccant Dryer: M-31531.
- C. Air Filters: FLT-31531A.

1.03 TERMINAL POINTS

- A. Terminal points for piping at the limits of the nitrogen system skid shall be either flanged connections or sweated copper fittings.

1.04 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. MG 1, Motors and Generators.

1.05 SUBMITTALS

- A. Submittals shall comply with the requirements of Section 01 33 00, Submittal Procedures.
- B. Action Submittals:
 - 1. Model Selection.

GRFF OZONE SYSTEM REPLACEMENT

2. Equipment Cut Sheets with Dimensions, Bill of Materials including extra materials, Wiring Diagrams, Component Materials, Control Signals, and installation instructions.
3. Factory Test Results.

C. Informational Submittals:

1. Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturer's Field Services.
2. Operation and Maintenance Manual, in accordance with Section 01 78 23, Operation and Maintenance Data.
3. Field Testing Data, in accordance with Section 01 91 14, Equipment Testing and Facility Startup.

1.06 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

1. Intake Filter Cartridges: Two sets.
2. Prefilter Replaceable Elements: Two sets.
3. Special Tools: One set.
4. Dryer Tower Replacements: One set.
5. Compressor Rebuild Kits: One set.
6. Coalescing Filter Elements: Two sets.
7. Particle Filter Elements: Two sets.

B. Contain spare parts in suitable boxes clearly marked as to content.

1.07 SERVICE CONDITIONS

A. Material Handled: Ambient Air.

B. Inlet Temperature: 40 degrees F to 100 degrees F.

C. Inlet Elevation: 920 feet plus or minus above sea level.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. General:

1. Furnish equipment to replace existing installed on nitrogen boost skid including air compressors, desiccant dryer, controls, and accessories.

2. The following equipment shall be included on the nitrogen boost skid:
 - a. One (1.0 micron) coalescing filter upstream of dryer.
 - b. One pair of pressure-swing desiccant dryer towers with muffler, pressure rated for a minimum of 150 pounds per square inch gauge.
 - c. One (0.1 micron) absolute particulate filter downstream of dryer.
 - d. One flowmeter.
 - e. One pressure indicating transmitter.
 - f. One pressure-reducing valve.
 - g. One flow control valve.
 - h. One outlet connection for N2 feed to GOX line with flex coupling.
3. System shall be preassembled with associated valves, dryers, filters, instruments, and piping on a skid prior to shipment to the field.

B. Receiver Mounted Air Compressor(s):

1. Manufacturers and Products:
 - a. Anest Iwata.
 - b. Atlas Copco.
 - c. "Or-Equal."
2. Rotary scroll, duplex type.
3. Air cooled.
4. One hundred percent oil free. Lubricated compressors with oil removal filter will not be allowed.
5. Automatic unloading during startup.
6. Mount motor and compressor on common steel base attached to receiver. Motors shall be premium efficiency per NEMA MG 1 and have TEFC enclosures.
7. Compressor connected to motor by V-belt drive system with guard and convenient method of belt tensioning.
8. Capable of operating continuously at 105 degrees F inlet air temperature at specified output without overheating.
9. Equip with combination air intake filter/silencer and discharge cushion chamber.
10. Capacity: 28 cfm at 100 pounds per square inch gauge.
11. Operating Discharge Pressure: 100 pounds per square inch gauge.
12. Controls:
 - a. Automatic ON/OFF cyclic operation when in AUTO mode.
 - b. Enclosure: NEMA 250, Type 12, painted steel panel for indoor installation to house complete control system including:
 - 1) Main disconnect circuit breaker with external, lockable operating handle.
 - 2) Control power transformer.
 - 3) LOCAL/OFF/REMOTE switch.

GRFF OZONE SYSTEM REPLACEMENT

- 4) Pressure switches.
- 5) Relays.
- 6) System pressure indicator.
- 7) Indicating light(s).
- 8) Combination motor starters (NEMA Size 1 minimum) with overload protection.
- c. Control Panel: Mount in accessible location on skid.
- d. Pre-wired control components.
- e. Control Components: Operate on 120-volt ac power supply.
- f. Power Supply: 480 volts, three-phase, 60-Hz.
- g. Coordinate control functions with Ozone Master Control Panel (OMCP).
- h. Coordinate control tags (status, control, alarms) to be monitored by Plant SCADA system. Provide the following information as a minimum:
 - 1) Discrete Inputs: System Enable from OMCP.
 - 2) Discrete Outputs:
 - a) ON status, one per compressor.
 - b) FAIL status, one per compressor.
 - c) REMOTE status.
 - d) Discharge Valve FAIL status.
 - 3) Analog Output:
 - a) Discharge flow.
 - b) Discharge pressure.
 - 4) Analog Input: Discharge valve position command from OMCP.

2.02 ACCESSORIES

- A. Flexible discharge connection manufacturer and product: U.S. Flex; BMH.

2.03 SHOP/FACTORY FINISHING

- A. Furnish manufacturer's standard enamel finish, color as selected.

2.04 SOURCE QUALITY CONTROL

- A. Factory Tests and Adjustments: Test all equipment actually furnished and provide certified test results.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Install equipment on skid replacing existing equipment in kind.

B. Air Compressor Piping:

1. Install in accordance with manufacturer's piping diagrams.
2. Contractor to modify compressed air piping to connect to new installed equipment.

3.02 FIELD QUALITY CONTROL

A. Functional Tests:

1. Vibration Test:
 - a. System shall not develop amplitudes of vibration in excess of manufacturer's recommendations.
 - b. Test with unit installed and in normal operation.
 - c. If unit exhibits vibration in excess of the manufacturer's recommendations, adjust or modify as necessary. If units cannot be adjusted or modified to conform as recommended by manufacturer, unit shall be replaced.

B. Performance Test:

1. Test for a continuous 2-hour period without malfunction.
2. Perform with Engineer present.
3. If equipment does not meet manufacturer's specifications, adjust, realign, or modify units and retest.
4. Perform under actual operating conditions prior to the ozone generator performance tests.

3.03 MANUFACTURER'S SERVICES

- A. Manufacturer's Representative: Services to be provided for the compressor system shall be as specified in Section 01 43 33, Manufacturers' Field Services.
- B. Training of Owner's Personnel: Training to be provided for the compressor system shall be as specified in Section 01 43 33, Manufacturers' Field Services.
- C. Performance Testing provided by OSS, per Veolia Power Supply Unit Procurement Proposal and Control Panel Procurement Proposal, Section 44 44 56.12, Ozone System, included in Part 3.

END OF SECTION

PART 3

**VEOLIA POWER SUPPLY UNIT PROCUREMENT PROPOSAL AND
CONTROL PANEL PROCUREMENT PROPOSAL**



Power Supply Unit Replacement

Proposal No.: 487817

Revision: 003A

City of Tacoma

Green River WTP

March 14, 2025

Contact information:

VEOLIA WATER TECHNOLOGIES & SOLUTIONS

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March 14, 2025

To whom it may concern
City of Tacoma, Washington
Green River WTP
39392 Green River Headworks Rd.
Ravensdale, WA
78051, USA

Subject: Power Supply Unit Replacement
City of Tacoma
Green River WTP
Proposal No. **487817** Rev. **003A**

To whom it may concern

Veolia Water Technologies Treatment Solutions USA, Inc. (formerly known as VEOLIA Treatment Solutions, Inc, hereinafter referred to as "Veolia") is pleased to provide our proposal for the work to be accomplished at the Green River WTP, in Tacoma, WA.

At a high level, this proposal will offer to replace the Power Supply Units #1 and #2 with the latest Veolia power converting technology. Additionally, the two (2) ozone generators associated with the Power Supply Units being replaced will be cleaned, and reconditioned.

Veolia shall provide the equipment and services as detailed below.

Note:

VEOLIA Water Technologies & Solutions (VEOLIA WTS) was acquired by the Veolia Group on January 18, 2022. While integration into the Veolia Group is on-going, and we now operate under the Veolia Water Technologies & Solutions (Veolia WTS) banner. The actual legal entity name we operate under has officially changed to "Veolia Water Technologies Treatment Solutions USA, Inc.". Our tax identification number and our banking information remain unchanged. For future project, make sure that purchase orders, payments and other legal documents recognize the new legal entity name.

If there are any questions or if additional information is required, please do not hesitate to contact us. We look forward to working with you on this project.

Very truly yours,

A handwritten signature in black ink, appearing to read 'Vito Ruvo'.

Vito Ruvo
Technical Sales Lead – Municipal Ozone
Veolia Water Technologies – Treatment Solutions USA, Inc.



Proposal and Contract

To: To whom it may concern
 City of Tacoma, Washington
 Green River WTP
 39392 Green River Headworks Rd.
 Ravensdale, WA
 78051, USA

Proposal No.: **487817 Rev. 003A**

Date: **March 14, 2025**

For: **Power Supply Unit Replacement
 City of Tacoma
 Green River WTP**

(Hereinafter referred to as "Purchaser")

Veolia Water Technologies – Treatment Solutions USA, Inc (hereinafter referred to as "Veolia") offers to furnish the following described materials and equipment ("Products") and/or services at the prices ("Purchase Price") stated herein and in accordance with the Conditions of Sale and other provisions contained or referenced herein. This proposal shall remain in effect unless extended in writing by Veolia. The Purchase Price is based upon only the Conditions of Sale and other provisions specifically contained or referenced herein. Purchaser's acceptance of this Purchase Price, whether by issuance of a purchase order or otherwise, or acceptance of delivery of the Products and/or services furnished hereunder, shall be considered acceptance by the Purchaser of all the Conditions of Sale and other provisions contained or referenced herein, notwithstanding any statement in Purchaser's acceptance or order to the contrary. Veolia hereby objects to and rejects any proposal by Purchaser to modify, amend, limit, add to or delete any of the Conditions of Sale or other provisions contained or referenced herein unless expressly accepted in writing by Veolia.

This Proposal and any resulting contract shall be referred to hereinafter as "this Contract".

Reference documents:

The above to be provided as described herein, complemented by the clarifications and deviations sections.

- **DIVISION 01 - GENERAL REQUIREMENTS**
 - 01 11 00 - Summary of Work
 - 01 88 15 - Anchorage and Bracing
- **DIVISION 40 - PROCESS INTERCONNECTIONS**
 - 40 99 90 - Package Control Systems
- **DIVISION 44 - POLLUTION AND WASTE CONTROL EQUIPMENT**
 - 44 44 56 - Ozone System - General
 - 44 44 56.01 - Ozone Generator Power Supply Unit
 - 44 44 56.11 – Ozone System Suppliers Service
 - 44 44 56.12 – Ozone System Performance Testing
- **Email – Tessoro Young – Dated February 14th 2025**
- **Email – Tessoro Young – Dated February 28th 2025**



TABLE OF CONTENTS

1	SCOPE OF SUPPLY	1
1.1	BASE PROPOSAL.....	1
2	TERMS AND ABBREVIATIONS.....	2
3	BASE PROPOSAL	3
3.1	ENGINEERING - GENERAL.....	3
3.2	ENGINEERING – POWER SUPPLY UNIT/POWER SUPPLY UNIT CONTROL PANEL (TYPICAL OF 2)	3
3.3	EQUIPMENT	5
3.3.1	<i>Power Supply Unit/Power Supply Unit Control Panel (Typical of 2).....</i>	<i>5</i>
3.3.2	<i>Ozone Generator (Typical of 2)</i>	<i>6</i>
3.4	FACTORY SERVICES	7
3.4.1	<i>Witnessed Factory Testing</i>	<i>7</i>
3.5	SPARE PARTS & SPECIAL TOOLS	7
3.6	SITE SERVICES.....	7
3.6.1	<i>Site Survey.....</i>	<i>8</i>
3.6.2	<i>Installation Assistance (during first PSU replacement).....</i>	<i>8</i>
3.6.3	<i>Post Installation Start-Up – PSU & OG #1.....</i>	<i>8</i>
3.6.4	<i>Post Installation Start-Up – PSU & OG #2.....</i>	<i>8</i>
3.6.5	<i>Baseline Performance Test – PSU & OG #1</i>	<i>9</i>
3.6.6	<i>Baseline Performance Test – PSU & OG #2.....</i>	<i>9</i>
4	BASELINE PERFORMANCE TESTING	10
5	SCHEDULE/TIMEFRAME	11
6	WARRANTY	12
7	CLARIFICATION AND SPECIFICS	13
8	DEVIATIONS	14
9	EXCLUSIONS TO VEOLIA SCOPE OF SUPPLY	16
9.1	WITNESSED FACTORY TESTING	16
9.2	CONTROL PANEL MODIFICATION.....	16
9.3	SCADA/DCS DEVELOPMENT	16
9.4	GENERALIZED WORK	16
10	GENERAL.....	17
10.1	SHIPMENT AND SCHEDULES	17
10.2	SHOP TESTING OF EQUIPMENT:.....	17
11	CONDITIONS OF FIELD SERVICE	18
12	GENERAL TERMS AND CONDITIONS OF SALE – SALE OF CAPITAL EQUIPMENT.....	19
13	SELLING PRICE	24
14	APPENDIX “A” – DETAILED GENERATOR CLEANING SERVICE AND PARTS	26



1 Scope of Supply

Veolia is pleased to provide the [City of Tacoma](#) (hereafter referred to as “the client”) our proposal for the work requested of Veolia, in association with the [replacement of Power Supply Unit #3 pertaining to the ozone system](#) at the [Green River WTP](#), in [Tacoma, WA](#).

1.1 Base proposal

- PSU model number: IPS-16-0400-WE-12 (Qty: 2)
 - Provide an entirely new cabinet; footprint and general arrangement will differ from the existing
 - Internal power cables prewired and terminated
 - Internal control cables prewired from I/O modules to terminals, utilising Veolia mechanical & electrical standards (type of terminals, wire colors, etc.)
 - Panel will be equipped with new Programmable Logic Controller (PLC) processor, appropriate Input/Output (I/O) modules, new Operator Interface Terminal (OIT)
 - Two (2) communication protocols will be provided:
 - Serial-based communication, utilising ProfiBUS/DP, to accommodate the existing communication protocol with the existing, non-modified, MOCP.
 - Ethernet-based communication, utilising ProfiNet (SIEMENS), to accommodate the link between the PLC and the OIT. This protocol will be used in the future, when the MOCP and the rest of the control system is upgraded during a separate project.
 - Replacement High Voltage (HV) cables (between PSU and ozone generator vessel)
- **Factory Services**
 - **Witnessed Factory Testing**
- **Spare Parts & Special Tools (Qty: 1)**
 - **Lot of parts**
- Packing & freight to jobsite
- **Site Services**
 - **Site Survey**
 - **Ozone Generator Cleaning, and Reconditioning - Parts & Services**
 - **Removal of existing dielectrics and cleaning of ozone generator**
 - **Replacement of internal failed components (dielectrics, fuses, rods, etc.)**
 - **Replacement of O-rings**
 - **Purging**
 - Start-Up/Commissioning
 - Baseline Performance Testing
 - Training



2 Terms and Abbreviations

TERM	DESCRIPTION	REFERS TO
MOCP	Master Ozone Control Panel	CP-31000
PSU (typical)	Power Supply Unit	PSU-31151 / PSU-31152
PSUCP (typical)	Power Supply Unit Control Panel	CP-31001 / CP-31002
OIT	Operator Interface Terminal	N/A



3 Base Proposal

3.1 Engineering - General

Veolia will provide the following services during the engineering & execution phase of the project

- Project Management, which will include...
- Kick-off meeting (Virtual)
- Scheduling and coordination
- Engineering, which will include...

The format and the level of detail of the engineering documents will be, at a minimum, as per Veolia's standard documentation.

- General design and installation information for installation of equipment provided by Veolia
- Storage, handling, and erection requirements, when applicable
- Operations and Maintenance Manuals
- Equipment, Valves, and Instrumentation Submittals, where applicable
- Layout drawings, including overall skid footprint dimensions, overall height, clearance requirements around each skid, control panel location, terminal junction box location, and sizes and locations of gas, water, drain, and power connections (where applicable).
- Bill of materials, calculation sheets and sizing data, as applicable, along with datasheets and manufacturer's cut-sheets.
- Valve and instrument schedules (when applicable)
- Electrical schematics, panel layouts and interconnecting terminal block drawings for all controls and instrument.
- Amperage and voltage ratings for each equipment's electric feeder.
- Specific demolition documents & instructions
- Anchorage and Bracing design and calculations (section 01 88 15, par. 1.01.B)
 - Designed by a qualified professional engineer registered in the State of Washington (section 01 88 15, par. 1.04.A.1)
 - See "Clarifications and specifics" section 6.g) for additional details
- A maximum of three (3) "Application software development Workshops", held in teleconference, up to one (1) hour duration each, to discuss and review which aspects of the PLC and OIT programming can be adapted to the end-user's requirements (reference to section 44 99 90, par. 1.04)
 - See "Clarifications and specifics" section 6.e) for additional details

3.2 Engineering – Power Supply Unit/Power Supply Unit Control Panel (Typical of 2)

See "Clarifications and specifics" section 6.a) for additional details

- PLC List of Inputs and Outputs (I/O List)
 - PSUCP-PLC
- PLC Program

Programming (organization, tagging, function blocks, etc.) will follow Veolia standards

- PSUCP-PLC program (typical) will be provided new
 - Local Control & Monitoring [Associated] with Ozone Generator
 - Normal Start-Up & Shutdown Sequencing
 - Emergency Shutdown Sequencing



- Closed-Loop Concentration Control with Feed-Forward Bias
- Enhanced Monitoring of Power Converter
- Operator Interface Terminal (OIT) Program

Programming (symbols, colors, layouts, etc.) will follow Veolia standards

- PSUCP-OIT program (typical) will be provided new
 - Functionalities, features, and controls will be fully compatible with new PSUCP-PLC
- PLC Tags/Variables List

Used for developing both the associated OIT and plant-level SCADA/DCS

- PSUCP-PLC (typical)
- Inter-Controller Communication Table

Single document that will define the data exchange between PLCs.

- PSUCP01-PLC to/from MOCP-PLC
- PSUCP02-PLC to/from MOCP-PLC
- Operations Manual
 - Ozone Generator Operations Manual (as per the interfacing with PSUCP-OIT)
- Unwitnessed Factory Testing (UFT) Protocol

Document describing the tasks associated with the unwitnessed verification and testing of the supplied equipment to certify that all is properly assembled and is fully functional in accordance with assembly documents.

- Visual Inspection
- Power-Up
- Communication verification
- I/O Checkout (end-to-end; field to PLC/OIT)
- Operational functional validation (to the fullest extent possible)
- Witnessed Factory Testing (UFT) Protocol

Document describing the tasks associated with the witnessed verification and testing of the supplied equipment to demonstrate that all is properly assembled and is fully functional in accordance with assembly documents.

- Visual Inspection
- Power-Up
- Communication verification
- I/O Checkout (end-to-end; field to PLC/OIT)
- Operational functional validation (to the fullest extent possible)
- Operational Readiness Testing (ORT) Protocol

Document describing the tasks associated with the verification and testing of the supplied equipment to certify that all is properly installed and is connected in accordance with installation documents.

- Visual Inspection
- Power-Up
- Communication verification
- I/O Checkout (end-to-end; field to PLC/OIT/SCADA)
- Rudimentary/basic functional validation



- Functional Validation Testing (FVT) Protocol

Document describing the tasks associated with the verification and testing of the supplied equipment to certify that all is functioning as per design and as specified, in accordance with the project functional specification and the end user's expectations.

- Preliminary logic validation
- Pre-operational functional validation
- Operational functional validation

3.3 Equipment

3.3.1 Power Supply Unit/Power Supply Unit Control Panel (Typical of 2)

Veolia Ozonia® model [IPS-16-0400-WE-12](#) Medium Frequency Power Supply Units. These Power Supply Units (PSU) utilize the latest in IGBT (Insulated Gate Bipolar Transistor) power converter technology (Ozonia® I-Stacks) and are in full compliance with IEEE 519 electrical specifications.

The following are some of the advantages of a Power Supply Unit equipped with IGBT-based Power Converter technology, versus the older SCR (Silicon Controlled Rectifier) based technology:

- Operation at almost unity power factor (> 0.97) over the entire operating range
- Power to ozone generator vessel turndown of 100:1
- Low operating voltage < 4200 volts
- The upstream half of the power converter is equipped with an "Active front-end", eliminating the need for harmonic mitigation equipment that would need to be installed within the PSU, such as capacitor banks, apart from the power converter. The "Active front-end" feature on the power converter is equivalent to a PSU with 18-pulse SCR-based technology.
- Very low harmonics, below the latest requirement of IEEE519
- Constant frequency inverter switching at whole multiples of the line frequency.
- Line notching that is traditionally associated with SCR-based technology using diode converters is also eliminated.

Remote monitoring and connectivity are an additional combined feature of the IGBT-based (Ozonia® I-Stacks) power converter. By means of a common web browser, the power converter can be accessed without having to open the PSU doors, remotely from anywhere in the plant, via laptops, tablets, workstations and even a SCADA. Provided the infrastructure is available and permissions are granted, the power converters can also be access from a remote (external location) by Veolia service personnel. This feature allows real-time, remote troubleshooting and support and access to operational historical data, resulting in quick support to the plant personnel

- Hardware
 - Mechanical
 - NEMA-12 Painted Steel enclosure
 - Size (approximate): 120" (L) x 49" (W) x 92" (H)
- Automation & Control Components
 - PLC
 - SIEMENS
 - SIMATIC S7-1500 Series, CPU 1512SP-1 PN (or equivalent)
 - PLC I/O Structure
 - SIEMENS, SIMATIC ET 200SP Series
 - Operator Interface:



- SIEMENS, SIMATIC HMI Series
- TP 900 Comfort
- Communication Hardware (Ethernet)
 - SIEMENS
 - SCALANCE XC-200 Managed Series
 - Specifications:
 - Managed layer two switch, IEC62443-4-2 certified.
 - Full Gigabit, 12x 10/100/1000 Mbps RJ45 ports, 4x 1000 Mbps combo ports, 2x console port.
 - Redundant power supply.
 - PROFINET I/O Device, Ethernet I/P compliant.
 - ** Subject to change based on detailed engineering **
- Communication Hardware (Profibus/DP)
 - SIEMENS, SIMATIC S7-1500 Series
 - CP 1542.5
 - Connections: DB-9 (Profibus/DP Connector)
- Communication Hardware (Profinet)
 - SIEMENS, SIMATIC S7-1500 Series
 - CP 1543-1
 - Connections: RJ-45

3.3.2 Ozone Generator (Typical of 2)

- Hardware
 - High Voltage (HV) Cable
 - 4/0 (5kV)
 - Qty: 50 feet, on spool(s)
 - Return Cable
 - 4/0 (5kV)
 - Qty: 50 feet, on spool(s)
 - Ground Cable
 - #4 AWG (bare copper)
 - Qty: 50 feet; on spool(s)
 - Cold shrink termination kits
 - Qty: 4

See “Clarifications and specifics” section 6.b) for additional details.

- Adapter Kits for connecting new HV cables to existing HV bushing on the ozone generator (if required)
 - Qty: 1



3.4 Factory Services

3.4.1 Witnessed Factory Testing

- Verification and testing of two (2) Power Supply Units to demonstrate that all is properly assembled and is fully functional in accordance with assembly documents (to the fullest extent possible)

TOTAL Man-days	TOTAL Calendar-days	TOTAL Man-hours	TRIPS
*	2	*	0

3.5 Spare Parts & Special Tools

Lot of spare parts as defined in section 40 99 90, paragraph 1.06

- Hardware (where applicable)
 - Selector Switches, Pushbuttons, and Indicating Lights:
 - Qty: 20% of total, minimum of one (1) of each type used.
 - Light Bulbs
 - Qty: 100% of total, minimum of two (2) of each type used
 - Fuses
 - Qty: 100% of total, minimum of five (5) of each type used.
 - Surge Suppressors:
 - Qty: 20% or total, minimum of one (1) of each type used.

Lot of spare parts as defined in section 44 44 56.01, paragraph 1.04.A.1.d.

- In addition to the components included with the “Ozone Generator Cleaning, Reconditioning” service” (see appendix “A”)
 - Dielectric Fuses: 10 % of one generator load
 - Qty: 20
 - Head Gaskets: Two per generator
 - Qty: 4
 - **PSU** Fuses: One complete replacement set for one **PSU**
 - ** Previously included. See spare parts hardware list from section 40 99 90, paragraph 1.06
 - Complete **Field-Replaceable** circuit board replacement set for one PSU
 - Various
 - Two sets of air filters for PSU
 - Qty: **Not Applicable. PSU is not equipped with air filters**
 - Special Tools: One complete set of special tools required to dismantle equipment.
 - Various

3.6 Site Services

Definition of “calendar-days” is Monday through Friday.

See section “**Conditions of Field Service**” of this proposal for definitions of WORK, TRAVEL and STANDBY TIME and the rates that apply to each. Please note the three (3) applicable rates that would apply if service is required in addition to the times allotted by the base proposal.

All times include travel.

This will be a phased installation, where only one unit will be replaced at a time.



3.6.1 Site Survey

- Review present installation, take detailed measurements, discuss the improvement requirements

TOTAL Man-days	TOTAL Calendar-days	TOTAL Man-hours	TRIPS
*	2	*	1

3.6.2 Installation Assistance (during first PSU replacement)

- Review concerns with installations and provide guidance where applicable

TOTAL Man-days	TOTAL Calendar-days	TOTAL Man-hours	TRIPS
*	2	*	1

3.6.3 Post Installation Start-Up – PSU & OG #1

- Ozone Generator Cleaning, Reconditioning
 - Details on the parts and services being provided can be found in Appendix “A”.
 - Upon completion of the generator cleaning, any unused or surplus parts will be returned to the client.
- Final Inspection
- Operational Readiness Testing
- Commissioning
- Functional Validation Testing
- Training

TOTAL Man-days	TOTAL Calendar-days	TOTAL Man-hours	TRIPS
*	10	*	Multiple

3.6.4 Post Installation Start-Up – PSU & OG #2

- Ozone Generator Cleaning, Reconditioning
 - Details on the parts and services being provided can be found in Appendix “A”.
 - Upon completion of the generator cleaning, any unused or surplus parts will be returned to the client.
- Final Inspection
- Operational Readiness Testing
- Commissioning
- Functional Validation Testing

TOTAL Man-days	TOTAL Calendar-days	TOTAL Man-hours	TRIPS
*	10	*	Multiple

**3.6.5 Baseline Performance Test – PSU & OG #1**

TOTAL Man-days	TOTAL Calendar-days	TOTAL Man-hours	TRIPS
*	2	*	1

3.6.6 Baseline Performance Test – PSU & OG #2

TOTAL Man-days	TOTAL Calendar-days	TOTAL Man-hours	TRIPS
*	2	*	1



4 Baseline Performance Testing

Existing Ozone Generator and Power Supply Unit will be tested to demonstrate that specific ozone rates can be produced at the intended constant in-gas ozone concentration, at the noted specific energy consumption.

Test Point	Production Rate	Ozone Concentration	CW Temperature (@ vessel)	Specific Energy Consumption
#1	1,400 lbs/day	10	79 °F	<= 5.0 kWh/lbs
#2	1,200 lbs/day	12	79 °F	<= 5.0 kWh/lbs

Baseline Performance testing will utilise the existing cooling water system and the testing will be executed at the highest cooling water temperature that is present at the time of testing.

Veolia will attempt to adjust the temperature of the water supplying to the vessel to achieve the desired closed-loop cooling water temperature supplying the vessel.

If cooling water temperature supplying the vessel is less or more than the specified temperature at the time of testing, power consumption will be adjusted to power consumption at maximum cooling water temperature conditions based on the difference between measured generator inlet cooling water temperature, specified cooling water temperature, and data from Veolia generator tables for kWh/lb vs. cooling water temperature.

For each generator production test point, five (5) consecutive readings to be taken and recorded at 15-minute interval after steady-state ozone production conditions have been attained. The recorded data to include the time, oxygen flow rate, inlet oxygen pressure, oxygen inlet temperature, oxygen outlet temperature, cooling water outlet flow, cooling water inlet temperature, cooling water outlet temperature, real power draw, ozone concentration, calculated ozone production, and specific energy.

The Baseline Performance Test will be coordinated with the Owner such that the maximum ozone production and duration required for the test can be accommodated with the current plant water production and ozone demands.

Additionally, as per section 44 44 56.12, paragraph 3.02., harmonic distortion shall be measured for each generator operating at each test point and up to its maximum production capacity from 10 percent loading to 100 percent loading (10 percent increments).



5 Schedule/Timeframe

The following remains to be finalized.

• Signing of Purchase order	TBD
• Submittal of detailed engineering:	10 Weeks (from date of contract signature)
• Fabrication, testing, packaging....	50 Weeks (from date of approved submittals)
• Delivery to site	1 Weeks (from release for delivery)
• Commissioning & Start-Up:	TBD



6 Warranty

Veolia shall provide the following warranty for the equipment provided under this proposal:

- Twelve (12) months following successful Start-Up/Commissioning or eighteen (18) months following delivery, whichever comes first.
- Warranty will cover the parts/components
- Warranty will not cover labor/service costs

NOTE: The above stipulation complements item e) of paragraph 6 of the “General Terms and Conditions of Sale”.



7 Clarification and specifics

- a) Veolia will produce one (1) set of "typical" drawings for any duplicate deliverable being provided. This also applies to "typical" documents, code files (PLC and OIT programs), etc. All documentation, drawings, and configuration files will be specific to the facility.
- b) Contractor to pull High Voltage, Return and Ground cables, through new HV conduits. Conduits are provided by others, Veolia will terminate High Voltage and Return cables, while contractor will terminate Ground cable.
- c) ~~There are no guarantees being provided by the "Baseline Performance Test". In order to guarantee that the ozone generator together with its new power supply unit will perform as per the listed production points, the ozone generator will, at a minimum, require a full cleaning and reconditioning followed by a minimum number of operating hours prior to executing the "Performance Test".~~
~~The ozone generator cleaning and reconditioning must be accomplished by certified Veolia personnel. Alternatively, the cleaning and reconditioning could be accomplished by the plant personnel while being assisted, in person, by certified Veolia personnel.~~
- d) In reference to any activities related to the Operational Readiness Test (ORT), Functional Validation Test (FVT) or Baseline (or otherwise) Performance Test (BPT), all expenses associated with consumables and utilities, such as, but limited to Liquid Oxygen (LOX) and power, which will be required during those mentioned activities, will be at the client's expense.
- e) Veolia's Programming Standards will apply. Veolia foresees that much of the time spent during the "Application software development Workshops" will focus on features that can be adapted specifically for this site, which are commonly the use of certain colors to represent specific states on the operator interface.
- f) Reference in section 44 44 56. Paragraph 1.03.B, "Notice To Proceed" will be interpreted by all parties as the moment that the contract resulting from this proposal is signed by Veolia.
- g) Veolia will limit its scope to providing seismic and anchor bolt calculations. Any hardware will be provided and installed by others.



8 Deviations

- Section 01 88 15. Paragraph 1.04.C.4 & 5
 - Support drawings and calculations for electrical distribution components as described in these paragraphs will not be provided by Veolia.
- Section 40 99 90. Paragraph 1.03.A.1.a.2), c)
 - Veolia will provide AutoCAD drawings developed in version 2023 or later.
- Section 40 99 90. Paragraph 1.03.B.5
 - Given that this proposal does not include any changes to the process and instruments on the ozone generators, Veolia will not be providing a new P&ID. Either the P&ID as issued by Veolia (then Ozonia) during the project that provided the generators originally, or a version of the P&ID as selected by the client, whichever best represents what is installed on the generators themselves.
 - This deviation also applies to Section 44 44 56, paragraph 2.01.G
- Section 40 99 90. Paragraph 1.03.C.2.e.2)
 - Although the data signals communicated between the new PSU and the *new future* MOCP is likely to be the same as the data signals communicated between the new PSU and the existing MOCP, it would be best to execute any engineering that relates to the *new future* MOCP outside this project.
- Section 40 99 90. Paragraph 1.04.A
 - Since no “project-wide application software standards” are being provided ahead of this proposal, Veolia’s offering will be based on “Veolia Programming Standards”.
 - This deviation also applies to Section 44 44 56.11, paragraph 1.06.A.1, 1.06.A.2, and 1.06.B
- Section 40 99 90. Paragraph 1.04.B
 - Veolia will not be providing SCADA graphics **directly**. Veolia’s participation to the “Application software development Workshops” will be to provide the SCADA programmer with the necessary information to develop the SCADA graphics, **based on the exported operator interface screens that Veolia will develop for their equipment. These exported operator interface screens will be provided to the client’s SCADA integrator who will then take responsibility for integrating them into the SCADA system.**
- Section 40 99 90. Paragraph 1.04.C.1, 2, 4
 - Veolia’s offering will be based on “Veolia Programming Standards”. Veolia will participate to the “Application software development Workshops”.
 - Provisions for a “Control Narrative” will not apply in the context of this project. Veolia will be providing standard equipment, which will include, amongst other documents, an operation manual for the PSU and its Ozone Generator, which could be interpreted as the “Control Narrative” for this equipment.
 - Given that this proposal does not include any changes to the process and instruments on the ozone generators, Veolia will not be providing a new P&ID. Either the P&ID as issued by Veolia (then Ozonia) during the project that provided the generators originally, or a version of the P&ID as selected by the client, whichever best represents what is installed on the generators themselves.
- Section 40 99 90. Paragraph 2.03.M
 - The cabinet for Veolia’s PSU is a custom designed enclosure and cannot be sourced as an off-the-shelf product from any of the three (3) suggested manufacturer.
- Section 40 99 90. Paragraph 2.05
 - Being that this is an existing system, which has an established tagging standard, this requirement cannot apply.
 - NOTE: No new instruments are being added as part of this project.
- Section 44 44 56. Paragraph 2.02.B.2



- The “Closed-Loop CW System” is existing. This proposal has no provisions to modify or replace said system.
- Section 44 44 56.01. Paragraph 2.01.C.5
 - No harmonic calculations will be provided as described in this section’s paragraph. Instead, Veolia will provide a standardized statement on the Power Supply Unit’s harmonics contributions which demonstrates our conformance to the guidelines set forth by IEEE 519.
- Section 44 44 56.01. Paragraph 2.02.C.2
 - Veolia can only generate alarms of process readings that already exist on the ozone generators. Veolia will reference agree upon P&ID’s and the existing PLC I/O list to determine the alarms that can and will be generated.
- Section 44 44 56.01. Paragraph 2.02.C.3
 - “External Interfaces”, defined as the data signals that are being passed between the existing MOCP and the new PSU, will follow the existing PSUs “external interfacing” so to match the existing MOCP’s expectations.
- Section 44 44 56.01. Paragraph 2.02.C.4
 - “Functional Requirements”, defined as the features that are accessible to the MOCP PLC, will be as per the interfacing requirements of the existing MOCP.
- Section 44 44 56.01. Paragraph 2.04.C
 - The Power Supply Unit will be tested at one-hundred pounds per square inch (100 psig) of pressure for one (1) hour.
- Section 44 44 56.12. Paragraph 2.02
 - “Calibration of Instruments for Performance Testing”, Instrument calibration services will not be provided for any existing instrument or any new instrument not provided by Veolia as part of this proposal and project.
- Section 44 44 56.12. Paragraph 3.02.D.1.i
 - “Sound and Pressure Level” data readings and/or calculations are not included in Veolia’s offering.



9 Exclusions to VEOLIA Scope of Supply

The following are excluded from the VEOLIA offer and will not be part of VEOLIA scope of supply. These will need to be provided by others:

~~9.1 Witnessed Factory Testing~~

~~There is no provision in the base offer for witnessed factory testing. An optional line item has been provided in addition to the base offer.~~

9.2 Control Panel Modification

Work associated with the addition of new hardware to existing/retained control panels will be done by others.

Work associated with modifications to the wiring of existing/retained control panels will be done by others.

9.3 SCADA/DCS Development

The development, management, and general responsibility of the client's SCADA/DCS will be done by others.

9.4 Generalized Work

The following items are not included in the proposed selling price and will be by others unless specifically called for in the body of this proposal:

- Removal and disposal of the existing Power Supply units, and any other component and equipment being demolished as part of this project
- Installation of the new Power Supply Units or any other component and equipment, both mechanically and electrically as stated in the submittal drawings
- Equipment unloading, storage or erection.
- Interconnecting and intra-connecting electrical wiring except in skid mounted packaged equipment.
- Interconnecting and intra-connecting oxygen, ozone or water piping and manual valves between the oxygen system components, ozone system components, equipment skids, contactors or ozone destruct system components except as noted.
- Wall sleeves and fittings.
- HVAC.
- Control wiring or piping.
- Insulation on ozone generators, cooling water piping, ozone destructors or other hot or cold surfaces.
- Air, ozone, liquid oxygen, gaseous oxygen or water piping.
- Anchor bolts
- Instruments and valves except as noted.
- Instrument air, instrument tubing or fittings.
- Power wiring and conduit.
- Motor control center and local disconnects.
- Field calibration of existing instruments.



10 GENERAL

The equipment described in this proposal will be of manufacturer's standard design and, where shipping tolerances require, will be shipped knocked down for installation in the field by others. This proposal does not include any expense for unloading, storage, erection, or supervision of erection.

The equipment to be furnished by VEOLIA will include only those major equipment items normally manufactured or supplied by VEOLIA as specifically listed in the equipment section of this proposal. Other items required to complete installation such as, but not limited to, wiring, conduit, starters, insulation, finish coats of paint, and pipe and fittings external to the major equipment components, will be done by others unless otherwise specified herein.

10.1 Shipment and Schedules

Shipment is quoted DDP. delivery site with truck freight allowed to job site. Costs of unloading these items at the site are not included under VEOLIA scope.

10.2 Shop Testing of Equipment:

Equipment will be functionally tested at the factory prior to shipment.



11 Conditions of Field Service

If this Contract does not include Field Service or if Purchaser requires such service in addition to that included in this Contract, Purchaser may purchase from VEOLIA such Field Service or technical advice during installation or start up of the Products, in which case Purchaser agrees to pay VEOLIA for Work Time, Travel Time and Standby Time based on (1) VEOLIA's "per diem" rates in effect at the time the service is performed; (2) the expenses of each ONA employee so furnished; and (3) the terms and conditions under which such service is performed.

"PER DIEM" CHARGES FOR SERVICE

The following rates are currently in effect. They are subject to change by VEOLIA and are based on the definitions below. These rates are for domestic service only. Rates for service outside the Continental United States will be quoted upon request.

Classification of Serviceman	Straight Time Rate	
STANDARD SERVICE	\$ 1490.00	Per day
PROGRAMMING SERVICE	\$ 1500.00	Per day

TIME DEFINITIONS

(a) Work Time - shall include all hours that VEOLIA service personnel are on Purchaser's job site, either working or ready for work, and shall be payable at the applicable specified rates.

(b) Travel Time - shall include the time spent by VEOLIA service personnel in traveling between their customary headquarters and Purchaser's job site and in returning (including travel occurring on Saturdays, Sundays and holidays) up to a maximum of eight (8) hours chargeable time for any given one-way trip. Travel Time shall be paid for at the applicable Straight Time Rate and shall not be cumulative with Work Time in determining Overtime.

(c) Standby Time - shall include all time (excluding Work Time) that VEOLIA service personnel are available for work at Purchaser's job site, whether on the job site or not, up to a maximum of eight (8) hours per day, between the hours of 7:00 a.m. and 6:00 p.m., Sunday through Saturday, including holidays if availability has been requested by Purchaser. Standby Time shall be paid for at the applicable Straight Time Rate; however, Standby Time preceded and/or followed by Work Time is cumulative in determining Overtime.

RATE DEFINITIONS

(a) Straight Time Rate - This rate shall be paid for Work Time, Standby Time or Travel Time on a regular schedule of eight (8) hours per day, Monday through Friday.

(b) Time and One-Half Rate - The rate of one and half (1-1/2) times the Straight Time Rate shall be paid for any Work Time or Standby Time in excess of eight (8) hours, but not exceeding sixteen (16) hours, per day, Monday through Friday, and for any Work Time or Standby Time on Saturdays, not to exceed sixteen (16) hours.

(c) Double Time Rate - The rate of twice the Straight Time rates shall be paid for time worked in excess of sixteen (16) hours per day, without a six (6) hour break, Monday through Saturday, and for all time worked on Sundays and holidays. Holidays shall be those observed in the locality where the work is to be performed.

CHARGES FOR EXPENSES

In addition to the "Per Diem" charges above, Purchaser shall pay VEOLIA for all the traveling and living expenses and all other expenses of each VEOLIA employee incidental to the work.

TERMS AND CONDITIONS

(1) Notification - Purchaser shall give VEOLIA at least two (2) weeks advance notice when ordering Field Service.

(2) Terms of Payment - Purchaser shall pay VEOLIA immediately upon receipt of invoices covering the time and expenses of VEOLIA's employees furnished for such services. OVERDUE PAYMENTS NOT RECEIVED BY VEOLIA WITHIN THIRTY (30) DAYS FROM DATE OF INVOICE SHALL BE SUBJECT TO FINANCE CHARGES AT THE RATE OF ONE AND ONE-HALF PERCENT (1-1/2%) PER MONTH.

(3) Time Sheets - VEOLIA employees shall present Purchaser at the end of each week or at the completion of the job if less than one (1) week, appropriate documents on which shall be indicated the number of hours spent and the estimated expense incurred on this work. Purchaser shall sign these documents in the place indicated, thus signifying approval of the time spent and estimated expense incurred on this work.

(4) Delays - If the work of an VEOLIA employee is postponed or suspended by Purchaser or is delayed or does not proceed with reasonable dispatch, due to no fault of VEOLIA, VEOLIA may withdraw such employee and return a serviceman to the job when needed and available; and any additional costs (including Travel Time and expenses) incurred by VEOLIA because of this shall be an additional charge to Purchaser.

(5) Limitation of Liability - VEOLIA in providing any Field Service hereunder, shall do so in an advisory capacity only and shall not be held responsible in any way for the acts, workmanship or omissions of the employees, contractors, sub-contractors or agents of Purchaser. VEOLIA SHALL NOT BE LIABLE IN ANY EVENT FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGE.



12 General Terms and Conditions of Sale – Sale of Capital Equipment

1. **Exclusive Terms and Conditions.** Together with any other terms the Parties agree to in writing, these General Terms and Conditions – together with the last proposal in order of time issued by the Seller – form the exclusive terms ("Agreement") whereby Buyer agrees to purchase, and Seller agrees to sell products and equipment (jointly "Equipment") and to provide advice, instruction and other services in connection with the sale of that Equipment ("Services"). If Buyer sends to Seller other terms and conditions to which Seller may not respond, including but not limited to those contained in Buyer's purchase order, such shall not apply. This Agreement may only be revised by a change order approved in writing by both Parties. All terms not defined herein shall be defined in Seller's proposal.
 2. **Equipment and Services.** The Equipment to be delivered and the Services to be provided shall be as set out in this Agreement. Unloading, handling, storage, installation, and operation of Buyer's systems or the Equipment are the responsibility of Buyer. Buyer shall not require or permit Seller's personnel to operate Buyer's systems or the Equipment at Buyer's site.
 3. **Prices and Payment.** Buyer shall pay Seller for the Equipment and Services in accordance with the payment schedule (as set forth in Seller's proposal or, if applicable, in any special conditions agreed to in writing by the Parties). Unless otherwise specified in writing, payment is due net thirty (30) days from the date of Seller's invoice. Seller may require a Letter of Credit or other payment guarantee, in which case the stated amount of the guarantee will be adjusted by Buyer in the event of any currency-based adjustment to prices or payment amounts per the Payment Schedule, and Buyer shall deliver the adjusted guarantee within five (5) days of request by Seller. Buyer agrees to reimburse Seller for collection costs, including 2% (two per cent) interest per month (not to exceed the maximum amount permitted by applicable law), should Buyer fail to timely pay. Buyer shall have no rights to make any deduction, retention, withholding or setoff relating to any payments due under this Agreement.
 4. **Taxes and Duties** Seller shall be responsible for all corporate taxes measured by net income due to performance of or payment for work under this Agreement ("Seller Taxes"). Buyer shall be responsible for all taxes, duties, fees, or other charges of any nature (including, but not limited to, consumption, gross receipts, import, property, sales, stamp, turnover, use, or value-added taxes, and all items of withholding, deficiency, penalty, addition to tax, interest, or assessment related thereto, imposed by any governmental authority on Buyer or Seller or its subcontractors) in relation to the Agreement or the performance of or payment for work under the Agreement other than Seller Taxes ("Buyer Taxes"). The Agreement prices do not include the amount of any Buyer Taxes. If Buyer deducts or withholds Buyer Taxes, Buyer shall pay additional amounts so that Seller receives the full Agreement price without reduction for Buyer Taxes. Buyer shall provide to Seller, within one month of payment, official receipts from the applicable governmental authority for deducted or withheld taxes. Buyer shall furnish Seller with evidence of tax exemption acceptable to taxing authorities if applicable, prior to execution of the Agreement by both Parties or issuance by the Seller of the order acceptance. Buyer's failure to provide evidence of exemption at time of order will relieve Seller of any obligation to refund taxes paid by Seller.
 5. **Delivery, Title, Risk of Loss.** Unless otherwise specified in this Agreement, Seller shall deliver all Equipment to Buyer FCA (Incoterms 2010) Seller's facility. The time for delivery of the Equipment to Buyer shall be specified in this Agreement. Seller's sole liability for any delay in delivery of the Equipment shall be as expressly set out in this Agreement. The place of delivery specified herein shall be firm and fixed, provided that Buyer may notify Seller no later than forty-five (45) days prior to the scheduled shipment date of the Equipment of an alternate point of delivery, Buyer shall compensate Seller for any additional cost in implementing the change. If any part of the Equipment cannot be delivered when ready due to any cause not attributable to Seller, Buyer shall designate a climate-controlled storage location, and Seller shall ship such Equipment to storage. Title and risk of loss shall thereupon pass to Buyer, and amounts payable to Seller upon delivery or shipment shall be paid by Buyer along with expenses incurred by Seller. Services provided herein shall be charged at the rate prevailing at the time of actual use and Buyer shall pay any increase, and Buyer shall pay directly all costs for storage and subsequent transportation. Failure by Buyer to take delivery of the Equipment shall be a material breach of this Agreement.
- Title and risk of loss to the Equipment shall be transferred from Seller to Buyer at the point of delivery upon handover in accordance with this Agreement. Title and risk of loss to the Services shall pass as they are performed.
6. **Warranties and Remedies.** Seller warrants that Equipment shall be delivered free from defects in material, workmanship and title and that Services shall be performed in a competent, diligent manner in accordance with any mutually agreed specifications. Seller's warranty does not cover the results of improper handling, storage, installation, commissioning, operation or maintenance of the Equipment by Buyer or third parties, repairs or alterations made by Buyer without Seller's written consent, influent water which does not comply with agreed parameters, or fair wear and tear.

Unless otherwise expressly provided in this Agreement, the foregoing warranties are valid for:

- (a) chemicals and Services, for six (6) months from their date of delivery or the provision of Services;
- (b) consumables, including filters and spiral wound membranes (other than spiral wound membranes for process treatment), the earlier of twelve (12) months from date of first use of fifteen (15) months from their date of delivery;
- (c) spiral wound membranes for process fluid treatment, ninety (90) days from their date of first use;
- (d) ultrafiltration membranes (ZW500, ZW700B, ZW1000, ZW1500), twelve (12) months from their date of delivery;
- (e) **Equipment other than chemicals and consumables, the earlier of, twelve (12) months from acceptance or thirty (18) months from delivery of equipment;**
- (f) software, ninety (90) days from the date of receipt;
- (g) Equipment not manufactured by Seller, the warranty shall be the manufacturer's transferable warranty only,

Any claim for breach of these warranties must be promptly notified in writing, and Buyer shall make the defective item available to the Seller, or the claim will be void. Seller's sole responsibility and Buyer's exclusive remedy arising out of or relating to the Equipment or Services or any breach of these warranties is limited to repair at Seller's facility or (at Seller's option) replace at Seller's facility the defective item of Equipment, and re-perform defective Services. In performance of its obligations hereunder, Seller will not control the actual operation of either Buyer's systems or the Equipment at the Buyer's site.



Warranty repair, replacement or re-performance by Seller shall not extend or renew the applicable warranty period.

The warranties and remedies are conditioned upon (a) proper unloading, handling, storage, installation, use, operation, and maintenance of the Equipment and Buyer's facility and all related system in accordance with Seller's instructions and, in the absence, generally accepted industry practice, (b) Buyer keeping accurate and complete records of operation and maintenance during the warranty period and providing Seller access to those records, and (c) modification or repair of Equipment or Services only as authorized by Seller in writing. Failure to meet any such conditions renders the warranty null and void.

The Buyer will be entitled to assign to a subsequent owner of the Equipment the warranties of the Seller under this Agreement, provided that a prior written notification is sent to the Seller and the assignment agreement contains terms and conditions which provide the Seller with the protections of the warranties and limitations on liability contained in the Agreement. Subject to Buyer's compliance with the foregoing requirement, such warranty rights are expressly assignable by the Buyer to a subsequent owner of the Equipment. Except as provided herein, Buyer is not entitled to extend or transfer this warranty to any other party. The warranties and remedies set forth in this article are in lieu of and exclude all other warranties and remedies, statutory, express or implied, including any warranty of merchantability or of fitness for a particular purpose.

Unless otherwise expressly stipulated in this Agreement, Seller gives no warranty or guarantee as to process results or performance of the Equipment, including but not limited to product quality, flow, production, capacity, membrane life, chemical consumption, regulatory compliance or energy consumption.

7. General Indemnity. Seller shall indemnify and hold harmless Buyer from claims for physical damage to third party property or injury to persons, including death, to the extent caused by the negligence of Seller or its officers, agents, employees, and/or assigns while engaged in activities under this Agreement. Buyer shall likewise indemnify and hold harmless Seller from claims for physical damage to third party property or injury to persons, including death, to the extent caused by the negligence of the Buyer, its officers, agents, employees, and/or assigns. In the event such damage or injury is caused by the joint or concurrent negligence of Seller and Buyer, the loss shall be borne by each Party in proportion to its negligence. For the purposes of this article (i) "Third party" shall not include Buyer or any subsequent owner of the Equipment, their subsidiaries, parents, affiliates, agents, successors or assigns including any operation or maintenance contractor, or their insurer; and (ii) no portion of the Equipment is "third party property".

8. Compliance with Laws and Permits. All permits, authorisations, and licenses which are required to construct, install and/or operate Buyer's facility or equipment, to use the Equipment, or to manage and dispose of any wastes, discharges, and residues resulting from Buyer's use of the Equipment, shall be obtained and maintained by Buyer at Buyer's sole expense. Buyer is responsible for compliance with all laws and regulations applicable to the storage, use, handling, installation, maintenance, removal, registration, and labelling of all Equipment after delivery of the Equipment, as well as for the proper management and disposal of all wastes, discharges, and residues.

9. Buyer's Site Conditions. Buyer warrants that any data furnished to the Seller concerning conditions at Buyer's site (including but not limited to any existing Buyer facility, equipment or processes, influent water or other substances to be treated or measured with the Equipment) is accurate and complete, and the Seller reserves the right to utilize the most appropriate design compatible with generally accepted engineering practices, and to make changes in details of design, manufacture and arrangement of Equipment unless precluded by any limitations specified in this Agreement. Seller shall notify Buyer of (1) any conditions at Buyer's site which materially differ from those indicated in the data furnished by Buyer, (2) any previously unknown physical conditions at Buyer's site of an unusual nature, not revealed by previous investigations and differing from those ordinarily encountered in the type of work provided for in this Agreement, and (3) the presence of any Hazardous Materials (as defined below), the existence of a contaminated soil, unexploded ordinance, or archaeological remains. If such conditions cause an increase in Seller's cost or in the time required for the performance of Seller's obligations, Seller shall be entitled to an equitable adjustment in the Agreement price and an extension in the time for performance.

10. Hazardous Materials and Wastes. In the event that Seller encounters any Hazardous Materials (meaning toxic substances, hazardous substances, pollutants, contaminants, regulated wastes, or hazardous wastes as such terms may be defined or classified in any law, statute, directive, ordinance or regulations promulgated by any applicable governmental entity) at Buyer's site, other than Hazardous Materials introduced by Seller or that are otherwise the express responsibility of Seller under this Agreement, Buyer shall immediately take whatever precautions are required to legally eliminate such Hazardous Materials so that the Seller's work under this Agreement may safely proceed. At no time shall Seller be deemed to have taken title to or the responsibility for the management or disposal of any wastes, Hazardous Materials, influent water, any resultant product streams, wastewater streams, discharges, cleaning materials, or any other materials or substances processed by the Equipment or otherwise located at Buyer's site. Seller does not take responsibility for and hereby expressly disclaims responsibility for the characterization or disposal of wastes, Hazardous Materials, or for the identification, selection, or management of disposal facilities for any wastes.

11. Excusable Delays. Seller shall not be liable nor in breach or default of its obligations under this Agreement to the extent performance of such obligations is delayed or prevented, directly or indirectly, due to causes beyond the reasonable control of Seller, including, but not limited to: acts of God, natural disasters, unusually severe weather, fire, terrorism, war (declared or undeclared) epidemics, material shortages, insurrection, act (or omissions) of Buyer or Buyer's contractors/suppliers or agents, any act (or omission) by any governmental authority, strikes, labour disputes, transportation shortages, or vendor non-performance. The delivery or performance date shall be extended for a period equal to the time lost by reason of delay or non-performance, plus such additional time as may be necessary to overcome the effect of the delay or non-performance. If delivery or performance is delayed for a period exceeding 180 (one hundred and eighty) days, either Party may terminate this Agreement without further liability provided that Seller shall be paid an amount equal to that which would be payable to Seller under the article entitled "Termination". If Seller is delayed by any acts (or omissions) of Buyer, or by the prerequisite work of Buyer's other contractors or suppliers, Seller shall be entitled to an equitable adjustment in schedule, price and/or performance, as applicable.

12. Emergencies. If the safety of Seller's personnel is threatened or likely to be threatened by circumstances outside the reasonable control of Seller, including but not limited to war, armed conflict, civil unrest, riots, terrorism, kidnapping, presence of or exposure to hazardous materials, unsafe working conditions, or by the threat of such circumstances or a lack of adequate protections against such circumstances, Seller shall be entitled to take all necessary steps to ensure the security and safety of its personnel including the evacuation of personnel until such circumstances no longer apply. Any such occurrence shall be considered an excusable delay event. Buyer shall reasonably assist in the event of any such evacuation.



13. Confidentiality, Intellectual Property. Both Parties agree to keep confidential the other Party's proprietary non-public information, if any, which may be acquired in connection with this Agreement. Buyer will not, without Seller's advance written consent, subject Equipment to testing, analysis, or any type of reverse engineering. Seller retains all intellectual property rights including copyright which it has in all drawings and data or other deliverables (including the Equipment) supplied or developed under this Agreement. Buyer agrees that it will not file patent applications on the Equipment or any development or enhancement of the Equipment, or of processes and methods of using the Equipment, without Seller's express prior written permission. Buyer further agrees that in any event any such patents will not be asserted against Seller or its other buyers based upon purchase and use of such Equipment. Seller grants to Buyer a non-exclusive, non-terminable, royalty free license to use the intellectual property embedded in Equipment delivered to and paid for by the Buyer, as well as any drawings, design or data delivered to and paid for by the Buyer, for the purposes of owning, financing, using, operating and maintaining the relevant Equipment at Buyer's site. Such license may only be assigned to a subsequent owner of the Equipment or to an operations and maintenance subcontractor. Such license does not extend to the re-creation of the Equipment or the manufacture of spares or consumables by Buyer or third parties.

Any software Seller owns and provides pursuant to this Agreement shall remain Seller's property. Seller provides to Buyer a limited, non-exclusive and terminable royalty free project-specific license to such software for the use, operation or maintenance at Buyer's site of any Equipment purchased hereunder to which the software is a necessary component. Buyer agrees not to copy, sub-license, translate, transfer, reverse engineer, or decode the software.

Seller shall indemnify and hold harmless Buyer from any rightful claim of any third party that any Equipment or Service infringe a patent in effect in the USA, an EU member state or country of delivery (provided there is a corresponding patent issued by the USA or an EU member state), or USA copyright or copyright registered in the country of delivery. If the Buyer notifies the Seller promptly of the receipt of any such claim, does not take any position adverse to the Seller regarding such claim and gives the Seller information, assistance and exclusive authority to settle and defend the claim, the Seller shall, at its own expense and choice, either (i) settle or defend the claim and pay all damages and costs awarded in it against the Buyer, or (ii) procure for the Buyer the right to continue using the Equipment or Service, or (iii) modify or replace the Equipment or Service so that it becomes non-infringing, or (iv) remove the infringing Equipment and refund the price. The above paragraph shall not apply to any misuse of Equipment or Equipment which is manufactured to the Buyer's design, or to alleged infringement arising from the combination, operation, or use of any Equipment or Services with other equipment or services when such combination is part of any allegedly infringing subject matter. The foregoing list of sub-sections (i), (ii), (iii), and (iv) and related terms state the entire liability of the Seller for intellectual property infringement by any Equipment or Service.

14. Limitations on Liability. Notwithstanding anything else contained in this Agreement, to the maximum extent permitted by law, and regardless of whether a claim is based in contract (including warranty or indemnity), extra-contractual liability, tort (including negligence or strict liability), statute, equity or any other legal theory:

- (a) THE TOTAL LIABILITY OF THE SELLER AND OF ITS INSURER FOR ALL CLAIMS ARISING OUT OF OR RELATING TO THE PERFORMANCE OR BREACH OF THIS AGREEMENT OR USE OF ANY EQUIPMENT OR SERVICES SHALL NOT EXCEED THE TOTAL PRICE PAID BY BUYER UNDER THIS AGREEMENT OR (IN THE CASE OF AN AGREEMENT FOR SERVICES WITH A TERM OF MORE THAN ONE YEAR) THE ANNUAL PRICE PAYABLE BY BUYER UNDER THIS AGREEMENT;
- (b) IN NO EVENT SHALL SELLER BE LIABLE FOR ANY LOSS OF PROFIT OR REVENUES, LOSS OF PRODUCTION, LOSS OF USE OF EQUIPMENT OR SERVICES OR ANY ASSOCIATED EQUIPMENT, INTERRUPTION OF BUSINESS, COST OF CAPITAL, COST OF REPLACEMENT WATER OR POWER, DOWNTIME COSTS, INCREASED OPERATING COSTS, CLAIMS OF BUYER'S CUSTOMERS FOR SUCH DAMAGES, OR FOR ANY SPECIAL, CONSEQUENTIAL, INCIDENTAL, INDIRECT, PUNITIVE OR EXEMPLARY DAMAGES;
- (c) SELLER'S LIABILITY SHALL END UPON EXPIRATION OF THE APPLICABLE WARRANTY PERIOD, PROVIDED THAT BUYER MAY CONTINUE TO ENFORCE A CLAIM FOR WHICH IT HAS GIVEN NOTICE PRIOR TO THAT DATE BY COMMENCING AN ACTION OR ARBITRATION, AS APPLICABLE UNDER THIS AGREEMENT, BEFORE EXPIRATION OF ANY STATUTE OF LIMITATIONS OR OTHER LEGAL TIME LIMITATION BUT IN NO EVENT – TO THE EXTENT PERMITTED BY APPLICABLE LAW – LATER THAN FIVE (5) MONTHS AFTER EXPIRATION OF SUCH WARRANTY PERIOD.

For the purposes of this article, "Seller" shall mean Seller, its affiliates, subcontractors and suppliers of any tier, and their respective agents and employees, individually or collectively. If Buyer is supplying Seller's Equipment or Services to a third party, Buyer shall require the third party to agree to be bound by this article. If Buyer does not obtain this agreement for Seller's benefit for any reason, Buyer shall indemnify and hold Seller harmless from all liability arising out of claims made by the third party in excess of the limitations and exclusion of this article.

15. Termination. This Agreement and any performance pursuant to it may be terminated by either Party, and the consequences of such termination shall be as set out in the next paragraph, if the other Party

- (a) becomes insolvent, makes an assignment for the benefit of its creditors, has a receiver or trustee appointed for the benefit of its creditors, or files for protection from creditors under any bankruptcy or insolvency laws; or
- (b) fails to make any payment when due or to establish any payment security required by this Agreement, or commits a material breach or defaults in its material obligations under this Agreement, and such default is not cured within thirty (30) days of written notice from the other Party.

Upon the termination of this Agreement by Buyer for cause (i) Seller shall reimburse Buyer the difference between that portion of the Agreement price allocable to the terminated scope and the actual amounts reasonably incurred by Buyer to complete that scope, and (ii) Buyer shall pay to Seller (a) the portion of the Agreement price allocable to Equipment completed, and (b) amounts for Services performed before the effective date of termination. Upon the termination of this Agreement by Seller for cause Buyer shall pay to Seller within thirty (30) days of receipt of invoice the price of all Equipment or Services delivered at the date of termination, plus an amount equal to all costs and expenses incurred in the engineering, sourcing, financing, procurement, manufacture, storage and transportation of the Equipment including materials, work in progress and any cancellation charges assessed against Seller by Seller's suppliers including reasonable overhead and profit on all such costs and expenses. Alternatively, if any schedule of termination payments has been agreed between the Parties, Buyer shall pay to Seller within thirty (30) days of receipt of invoice the amounts set out in that schedule.

Seller shall have the right to suspend performance upon written notice to Buyer in any case where Seller would have the right to terminate the



Agreement under this article, without prejudice to Seller's right to terminate this Agreement for cause. Any cost incurred by Seller in accordance with any such suspension (including storage costs) shall be payable by Buyer upon submission of the Seller's invoice(s). Performance of the Seller's obligations shall be extended for a period of time reasonably necessary to overcome the effects of such suspension.

16. Governing Law, Dispute Resolution. This Agreement shall be governed by the substantive laws of the State of New York. In the event of a dispute concerning this Agreement, the complaining Party shall notify the other Party in writing thereof. Management level representatives of both Parties shall meet at an agreed location to attempt to resolve the dispute in good faith. Should the dispute not be resolved within thirty (30) days after such notice, the complaining Party shall seek remedies exclusively through arbitration. The seat of arbitration shall be the federal district court in Philadelphia, PA, and the rules of the arbitration will be the Commercial Arbitration Rules of the American Arbitration Association, which are incorporated by reference into this article.

Notwithstanding the foregoing, each Party shall have the right to commence an action or proceeding in a court of competent jurisdiction, subject to the terms of this Agreement, in order to seek and obtain a restraining order or injunction to enforce the confidentiality intellectual property provisions set forth in the first two paragraphs of article 13; nuclear use restrictions set forth in article 17, or to seek interim or conservatory measures not involving monetary damages.

17. No Nuclear Use. Equipment and Services sold by Seller are not intended for use in connection with any nuclear facility or activity, the Buyer warrants that it shall not use or permit others to use the Equipment or Services for such purposes, without the advance written consent of Seller. If, in breach of this, any such use occurs, Seller (and its parent, affiliates, suppliers and subcontractors) disclaims all liability for any nuclear or other damage, injury or contamination, and, in addition to any other rights of Seller, Buyer shall indemnify and hold Seller (and its parent, affiliates, suppliers and subcontractors) harmless against all such liability.

18. Export Control. Seller's obligations are conditioned upon Buyer's compliance with all applicable trade control laws and regulations including those of the United States, European Union, and France. Additionally, Buyer shall not sell, distribute, disclose, release or otherwise transfer any item or technical data provided under this Agreement to: (i) any country designated as a "State Sponsor of Terrorism" by the U.S. Department of State including, for this Agreement, the countries of North Korea (ii) any entity located in, or owned by an entity located in, a "State Sponsor of Terrorism" country, North Korea, (iii) the region of Crimea or (iv) any person or entity listed on the "Entity List" or "Denied Persons List", the list of "Specifically Designated Nationals and Blocked Persons" maintained by any other applicable prohibited party list. The Buyer hereby certifies that the work, technical data, software or other information or assistance furnished by the Seller or its Affiliates under this contract will not be used in the design, development, production, stockpiling or use of chemical, biological or nuclear weapons either by the Buyer or by any entity acting on the Buyer's behalf. The obligations of the parties to comply with all applicable trade control laws and regulations shall survive any termination or discharge of any other contract obligations.

19. Changes. Each Party may at any time propose changes in the schedule or scope of Equipment or Services. All changes to the Equipment or Services shall be subject to mutual agreement via a written change order or variation, which shall only become effective once signed by both Parties. The scope, Agreement price, schedule, and other provisions will be equitably adjusted to reflect additional costs or obligations incurred by Seller resulting from a change, after Seller's proposal date, in Buyer's site-specific requirements or procedures, or in industry specifications, codes, standards, applicable laws or regulations. It shall be acceptable and not considered a change if Seller delivers Equipment (including Equipment replacement under warranty) that bears a different, superseding or new part or version number compared to the part or version number listed in the Agreement, provided that in no circumstance shall this affect any other of Seller's obligations including those set forth in article 6.

20. Conflicts; Survival, Assignment. If there is any conflict between this Agreement and any written proposal or quotation provided by Seller, then the terms and conditions set forth in this Agreement shall prevail. If any term or condition of this Agreement or any accompanying terms and conditions are held invalid or illegal, then such terms and conditions shall be reformed to be made legal or valid, or deleted, but the remaining terms and conditions shall remain in full force and effect, and this Agreement shall be interpreted and implemented in a manner which best fulfills Parties' intended agreement. Those provisions which by their nature remain applicable after termination shall survive the termination of this Agreement for any reason. Seller may assign or novate its rights and obligations under the Agreement, in whole or in part, to any of its affiliates or may assign any of its accounts receivable under this Agreement to any party without Buyer's consent, and the Buyer hereby agrees, by signing this Agreement, to such assignment and to execute any document that may be necessary to complete Seller's assignment or novation. This Agreement shall not otherwise be assigned by either Party without the other Party's prior written consent, and any assignment without such consent shall be void.

Seller may (i) manufacture and source the Equipment and any part thereof globally in the country or countries of its choosing; and (ii) subcontract portions of the Services, so long as Seller remains responsible for such.

21. No third party beneficiary. Except as specifically set forth in the article entitled "Limitations on Liability" and "No Nuclear Use", this Agreement is not intended to, and does not, give to any person who is not a party to this Agreement any rights to enforce any provisions contained in this Agreement.

22. Entire Agreement. This Agreement embodies the entire agreement between Buyer and Seller and supersedes any previous documents, correspondence or agreements between them. No modification, amendment, revision, waiver, or other change shall be binding on either Party unless agreed in writing by the Party's authorized representative. Any oral or written representation, warranty, course of dealing, or trade usage not specified herein shall not be binding on either Party. Each Party agrees that it has not relied on, or been induced by, any representations of the other Party not contained in this Agreement.



Additional Clauses

*** **Insurance.** Buyer shall maintain all risk property and boiler and machinery breakdown insurance covering the full replacement value of Buyer's site, systems and related equipment, together with business interruption coverage, which includes a waiver of subrogation in favour of Seller and its affiliates. Prior to commencement of any work under this Agreement, and not less than annually thereafter during the term of this Agreement, Buyer shall deliver to Seller a certificate(s) of insurance and copy of waiver of subrogation endorsement evidencing that the foregoing insurance is in full force and effect. Seller shall maintain types and amounts of insurance against loss or damage and such other risks as customarily insured against by businesses whose operations are comparable to those of the Seller. Seller shall not be obliged to add Buyer or any other third party as an additional insured under Seller's insurance policies.

*** **Inspection and Factory Tests.** Seller will apply its normal quality control procedures in manufacturing the Equipment. Seller shall attempt to accommodate requests by Buyer to witness Seller's factory tests of Equipment, subject to appropriate access restrictions, if such witnessing can be arranged without delaying the work.

*** **Change control.** Buyer shall notify Seller immediately upon any change in ownership of more than fifty per cent (50%) of Buyer's voting rights or of any controlling interest in Buyer. If Buyer fails to do so or Seller objects to the change, Seller may (a) terminate the Agreement, (b) require Buyer to provide adequate assurance of performance (including but not limited to payment), and/or (c) put in place special controls regarding Seller's Confidential Information.



13 Selling Price

Item	Description	Price
1	Base offer	\$ 994,500 USD
TOTAL Selling Price:		\$ 994,500 USD (1)

(*) Note: No Sales Tax has been included. If required tax will be added to the selling price at the current rate when invoice is submitted.

SHIPPING TERMS DDP to jobsite

TERMS OF PAYMENT * Net 30 days
10% with Shop Drawing approval
80% upon shipment of equipment
10% upon successful commissioning and Testing, or one hundred eighty (180) days from shipment of equipment (whichever comes first)

VALIDITY **30 Days**

BONDING No Performance or Payment Bonds have been included in the above price

SERVICE Field Service included in this Contract shall be provided for a period not to exceed * eight-hour man days provided in not more than * • trips to check the completed installation by Purchaser, to place the Products in operation and to instruct Purchaser in their operation. Purchaser agrees to pay VEOLIA for any additional service days and/or trips in accordance with VEOLIA's standard service rates and conditions in effect at the time the service is performed. A minimum of one (1) full day of service will be charged to each trip. See proposal details

SCHEDULE Approval drawings and data shall be submitted approximately (see above) weeks after agreement to all terms, as evidenced by Veolia's receipt of this proposal, fully executed; or, in the event that Purchaser issues a Purchase Order, Veolia's receipt of fully executed letter agreement. Veolia estimates that shipment of the Products can be made in approximately (see above) weeks after Veolia has received from Purchaser final approval of all submittal drawings and data.

NOTES	
1	Given the current geopolitical uncertainty related to tariffs and trade regulations, Veolia cannot estimate what impact such changes will have on tariff rates, pricing, and the availability of goods. This proposal does not yet take into account the impact that the aforementioned situation will have on tariff rates, and as a result Veolia pricing and supply chain. Although you have Veolia's assurance that we are taking proactive measures to mitigate any impacts caused by these changes in tariff rates, Veolia does hereby reserve the right to adjust prices and schedule to reflect any impact incurred from the time of issuance of Veolia proposal.



PURCHASER'S ACCEPTANCE: BY ITS SIGNATURE BELOW OR ISSUANCE OF ANY PURCHASE ORDER OR OTHER DOCUMENT, NOTWITHSTANDING ANY STATEMENT OR PROVISION CONTAINED THEREIN TO THE CONTRARY, PURCHASER AGREES TO ALL THE CONDITIONS AND PROVISIONS OF THIS PROPOSAL AND CONTRACT. NO OFFER BY PURCHASER TO ALTER, AMEND, LIMIT OR DELETE ANY CONDITION OR PROVISION OF THIS PROPOSAL AND CONTRACT SHALL BE BINDING UPON VEOLIA UNLESS EXPRESSLY ACCEPTED IN WRITING BY VEOLIA.

PURCHASER'S ACCEPTANCE:

Name _____
Title _____

Company Name _____
Date: _____

Ship To:

SELLER

Name Vito Ruvo
Title Technical Sales Lead – Municipal Ozone

Company Name VEOLIA WATER TECHNOLOGIES
TREATMENT SOLUTIONS USA INC.
Date: March 14, 2025



14 APPENDIX "A" – DETAILED GENERATOR CLEANING SERVICE AND PARTS

Total number of pages for this appendix, including this one, is five (5).

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		Veolia Water Technologies Treatment Solutions USA Inc. 600 WILLOW TREE RD LEONIA NJ 07605 UNITED STATES PHONE: 1-201-676-2525		Quotation		
Quote Date		Quotation Exp. Date		Veolia TS Quote		
18NOV2024		18DEC2024		20642011		
Sales org.		Sales Representative / Contact		Reference		
B611		Jeff Bolam				
Sold to : 1000133937 City of Tacoma P.O. Box 1717 TACOMA WA 98401 UNITED STATES				Ship to : 4000216489 CITY OF TACOMA 36932 SE GREEN RIVER HEADWORKS ROAD RAVENSDALE WA 98051 UNITED STATES		
Bill to : 0000491717 City of Tacoma P.O. Box 1717 TACOMA WA 98401 UNITED STATES				Payment terms Net 30 Days From Invoice Date		
				Inco terms FCA FACTORY		
Currency: U.S. Dollar				Freight: Freight PrePaid and Add		
SNo.	Part Number / Item Description	Quantity	Unit	Price	Unit	Amount
10	Z1351H02 DIELECTRIC, AT-98H, L=540 MM 175 EA	175	EA	Included in proposal total price	EA	Included in proposal total price
20	Z0339H01 CONNECTING ROD, DUPLEX-AT95/98H, 2200 MM 50 EA	50	EA	Included in proposal total price	EA	Included in proposal total price
30	Z0215H10 ADAPTER, 7X 52 MM 50 EA	50	EA	Included in proposal total price	EA	Included in proposal total price
40	Z0326H01 HV FUSE - B7 OZONIA 120 TD 6.0 - B 415 EA	415	EA	Included in proposal total price	EA	Included in proposal total price
50	Z0103H01 NUT,METRIC,HEX,M4A4.8,55100 200 EA	200	EA	Included in proposal total price	EA	Included in proposal total price
60	Z0104H01 WASHER,METRIC,M4 DIN 125A, 200 EA	200	EA	Included in proposal total price	EA	Included in proposal total price
70	Z0215H11					

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 Freight for Bulk Delivery and specialized freight charges, where applicable, are not included unless specifically indicated in
 the materials listing above.
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Bill to : 0000491717 City of Tacoma P.O. Box 1717 TACOMA WA 98401 UNITED STATES				Payment terms Net 30 Days From Invoice Date		
				Inco terms FCA FACTORY		
Currency: U.S. Dollar				Freight: Freight PrePaid and Add		
SNo.	Part Number / Item Description	Quantity	Unit	Price	Unit	Amount
	HEX END CAP,M4X8X30					
	50 EA	50	EA	Included in proposal total price	EA	Included in proposal total price
80	Z0092H18					
	GASKET, HEAD, 47.312" ID X 1/2" THK,					
	4 EA	4	EA	Included in proposal total price	EA	Included in proposal total price
90	3097678					
	FEE,SERVICE VISIT,FIVE DAY					
	5 EA	5	EA	Included in proposal total price	EA	Included in proposal total price
100	3059963					
	FEE,T&L, EXPENSE					
	5 EA	5	EA	Included in proposal total price	EA	Included in proposal total price
110	3059959					
	FEE,T&L,AIRFARE					
	1 EA	1	EA	Included in proposal total price	EA	Included in proposal total price
120	3187393					
	FEE,SERVICE,SEE ORDER LONG TEXT					
	5 EA	5	EA	Included in proposal total price	EA	Included in proposal total price
130	3059963					
	FEE,T&L, EXPENSE					

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Bill to : 0000491717 City of Tacoma P.O. Box 1717 TACOMA WA 98401 UNITED STATES			Payment terms Net 30 Days From Invoice Date			
			Inco terms FCA FACTORY			
Currency: U.S. Dollar			Freight: Freight PrePaid and Add			
SNo.	Part Number / Item Description	Quantity	Unit	Price	Unit	Amount
140	5 EA 3059959 FEE,T&L,AIRFARE	5	EA	Included in proposal total price	EA	Included in proposal total price
150	1 EA 3097678 FEE,SERVICE VISIT,FIVE DAY	1	EA	Included in proposal total price	EA	Included in proposal total price
160	5 EA 3059963 FEE,T&L, EXPENSE	5	EA	Included in proposal total price	EA	Included in proposal total price
170	5 EA 3059959 FEE,T&L,AIRFARE	5	EA	Included in proposal total price	EA	Included in proposal total price
180	1 EA 3187393 FEE,SERVICE,SEE ORDER LONG TEXT	1	EA	Included in proposal total price	EA	Included in proposal total price
190	5 EA 3059963 FEE,T&L, EXPENSE	5	EA	Included in proposal total price	EA	Included in proposal total price
	5 EA	5	EA	Included in proposal total price	EA	Included in proposal total price

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 the materials listing above.
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Bill to : 0000491717 City of Tacoma P.O. Box 1717 TACOMA WA 98401 UNITED STATES				Payment terms Net 30 Days From Invoice Date		
				Inco terms FCA FACTORY		
Currency: U.S. Dollar				Freight: Freight PrePaid and Add		
SNo.	Part Number / Item Description	Quantity	Unit	Price	Unit	Amount
200	3059959 FEE,T&L,AIRFARE 1 EA All services are estimated amounts. Customer will only be invoiced for actual time and travel expenses. Expenses are estimated and will be invoiced at actual cost plus 15%. Contact:Jeff Bolam Phone: 253-954-6949 Jbolam@cityoftacoma.org	1	EA	Included in proposal total price	EA	Included in proposal total price
NET PRICE WA - STATE SALES/USE WA - KING COUNTY UNI				USD 6.50% 2.30%	Included in proposal total price	
TOTAL AMOUNT				See total selling price in proposal		

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 To ensure that you receive the pricing quoted, please reference this quotation number on your order.
 All sales are subject to our terms and conditions, contained with this quotation.
 Freight for Bulk Delivery and specialized freight charges, where applicable, are not included unless specifically indicated in the materials listing above.
 Pricing above does not include applicable taxes, which will be applied at time of order.



Supply & Delivery of Ozonation Control System Equipment & Services

**Proposal No.: 676385
Revision: 002**

City of Tacoma

Green River WTP

January 16, 2026

Contact information:

VEOLIA WATER TECHNOLOGIES & SOLUTIONS Prepared By:

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Local Sales Representative APSCO, LLC

Joshua Clark
Tel.: +1 (425) 822-3335
Email: jclark@apsco-llc.com

Green River FF[illegible]

A – Proposal



January 16, 2026

To whom it may concern
City of Tacoma, Washington
Green River WTP
39392 Gren River Headworks Rd.
Ravensdale, WA
78051, USA

Subject: Supply & Delivery of Ozonation Control System Equipment & Services
City of Tacoma
Green River WTP
Proposal No. **676385** Rev. **002**

To whom it may concern

Veolia Water Technologies Treatment Solutions USA, Inc. (formerly known as Veolia Treatment Solutions, Inc, hereinafter referred to as "Veolia") is pleased to provide our firm proposal for the work to be accomplished at the Green River WTP, in Tacoma, Washington.

This proposal will detail the goods and services as defined in the "CONTRACT DOCUMENTS for the construction of the GREEN RIVER FILTRATION FACILITY OZONE SYSTEM REPLACEMENT CONTROL PANEL PROCUREMENT" document, prepared by JACOBS and dated August 2025, where Veolia is requested to supply and deliver ozonation control system hardware and services.

Veolia shall provide the equipment and services as detailed below.

Note:

Veolia Water Technologies & Solutions (Veolia WTS) was acquired by the Veolia Group on January 18, 2022. While integration into the Veolia Group is on-going, and we now operate under the Veolia Water Technologies & Solutions (Veolia WTS) banner. The actual legal entity name we operate under has officially changed to "Veolia Water Technologies Treatment Solutions USA, Inc.". Our tax identification number and our banking information remain unchanged. For future project, make sure that purchase orders, payments and other legal documents recognize the new legal entity name.

If there are any questions or if additional information is required, please do not hesitate to contact us. We look forward to working with you on this project.

Very truly yours,

Veolia Water Technologies Treatment Solutions USA, Inc.

A handwritten signature in black ink, appearing to read 'Vito Ruvo'.

Vito Ruvo

Technical Sales Lead – Municipal Ozone



Proposal and Contract

To: To whom it may concern
City of Tacoma, Washington
Green River WTP
39392 Gren River Headworks Rd.
Ravensdale, WA
78051, USA

Proposal No.: **676385** Rev. **002**

Date: **January 16, 2026**

For: **Supply & Delivery of Ozonation
Control System Equipment &
Services
City of Tacoma
Green River WTP**

(Hereinafter referred to as "Purchaser")

Veolia Water Technologies – Treatment Solutions USA, Inc (hereinafter referred to as "Veolia") offers to furnish the following described materials and equipment ("Products") and/or services at the prices ("Purchase Price") stated herein and in accordance with the Conditions of Sale and other provisions contained or referenced herein. This proposal shall remain in effect unless extended in writing by Veolia. The Purchase Price is based upon only the Conditions of Sale and other provisions specifically contained or referenced herein. Purchaser's acceptance of this Purchase Price, whether by issuance of a purchase order or otherwise, or acceptance of delivery of the Products and/or services furnished hereunder, shall be considered acceptance by the Purchaser of all the Conditions of Sale and other provisions contained or referenced herein, notwithstanding any statement in Purchaser's acceptance or order to the contrary. Veolia hereby objects to and rejects any proposal by Purchaser to modify, amend, limit, add to or delete any of the Conditions of Sale or other provisions contained or referenced herein unless expressly accepted in writing by Veolia.

This Proposal and any resulting contract shall be referred to hereinafter as "this Contract".



TABLE OF CONTENTS

1	REFERENCE DOCUMENTS.....	1
1.1	ORIGINALLY RECEIVED	1
1.2	ADDENDUMS	1
1.3	APPLICABLE	1
1.4	SPECIFICATION REVIEW	1
2	ABBREVIATIONS	2
3	SCOPE OF SUPPLY – HIGH LEVEL	3
4	SCOPE OF SUPPLY - DETAILED.....	4
4.1	OXYGEN GAS HEADER.....	4
4.1.1	<i>General</i>	4
4.1.2	<i>Skidded Equipment</i>	4
4.1.3	<i>Loose Equipment</i>	4
4.2	SUPPLEMENTAL NITROGEN GAS HEADER	4
4.2.1	<i>General</i>	4
4.2.2	<i>Skidded & Pre-Assembled Equipment</i>	4
4.2.3	<i>Loose Equipment</i>	4
4.3	OZONE GENERATION SYSTEM.....	4
4.3.1	<i>General</i>	5
4.3.2	<i>Skidded & Pre-Assembled Equipment</i>	5
4.3.3	<i>Loose Equipment</i>	5
4.3.4	<i>Modified Equipment</i>	5
4.4	OZONE DELIVERY SYSTEM.....	5
4.4.1	<i>General</i>	5
4.4.2	<i>Skidded & Pre-Assembled Equipment</i>	6
4.4.3	<i>Loose Components</i>	6
4.5	OZONE CONTACTING AND OFF-GASSING SYSTEM	6
4.5.1	<i>General</i>	6
4.5.2	<i>Skidded & Pre-Assembled Equipment</i>	6
4.5.3	<i>Loose Components</i>	6
4.6	OZONE DESTRUCT SYSTEM	6
4.6.1	<i>General</i>	7
4.6.2	<i>Skidded & Pre-Assembled Equipment</i>	7
4.6.3	<i>Loose Components</i>	7
4.6.4	<i>Additional Information</i>	7
4.7	OZONE CONTROL SYSTEM	7
4.7.1	<i>General</i>	8
4.7.2	<i>Skidded & Pre-Assembled Equipment</i>	8
4.7.3	<i>Loose Components</i>	8
4.7.4	<i>Project Related Information</i>	8
4.7.5	<i>Notable Features</i>	9
4.7.6	<i>Project Specific Features</i>	9
4.8	SPARE PARTS & TOOLS	10
4.8.1	<i>Extra Materials – Specification 40 99 90, paragraph 1.06.A</i>	10
4.8.2	<i>Extra Material – Specification 44 44 56.07, paragraph 1.05.A</i>	11
4.9	ENGINEERING.....	11
4.9.1	<i>Team</i>	11
4.9.2	<i>Standard Service</i>	11
4.9.3	<i>Factory Testing (FT) Protocol (unwitnessed/witnessed)</i>	11
4.9.4	<i>Operational Readiness Testing (ORT) Protocol</i>	12
4.9.5	<i>Functional Validation Testing (FVT) Protocol</i>	12
4.9.6	<i>Coordination Meetings and Workshops</i>	12
4.9.7	<i>Specified and Specific Service</i>	12
4.10	FACTORY TESTING	13
4.10.1	<i>Location</i>	13



4.10.2	<i>Unwitnessed Factory Testing</i>	13
4.10.3	<i>Witnessed Factory Testing</i>	13
4.11	FIELD SERVICES (MEETINGS, INSPECTIONS, START-UP, TRAINING)	13
4.11.1	Site Survey	14
4.11.2	Commissioning & Start-Up	14
5	WARRANTY	15
6	CLARIFICATIONS	16
7	RECOMMENDATIONS	20
8	DEVIATIONS / EXCLUSIONS	21
9	SCHEDULE / TIMEFRAME	22
10	EXCLUSIONS TO VEOLIA SCOPE OF SUPPLY	23
10.1	GENERALIZED WORK	23
11	GENERAL	24
11.1	SHOP TESTING OF EQUIPMENT	24
11.2	DESIGN	24
11.3	SCOPE - MATERIAL	24
11.4	SCOPE - SERVICES	24
12	CONDITIONS OF FIELD SERVICE	25
13	GENERAL TERMS AND CONDITIONS OF SALE – SALE OF CAPITAL EQUIPMENT	26
14	SELLING PRICE	31



1 REFERENCE DOCUMENTS

1.1 Originally Received

- Tacoma_GRFF_Ozone_Replacement_Final_05AUG2025_Unlocked / Date August 2025 (356 pages)
- Tacoma Water_Ozone_Procurement 2_Drawings 100PCT_08-12-2025_STAMPED / Date August 2025 (15 pages)

1.2 Addendums

- Addendum No. 1_Veolia Phase 2 Procurement / Dated November 20, 2025 (89 pages)

1.3 Applicable

- 01 33 00 - Submittal Procedures
- 01 78 23 - Operation and Maintenance Data
- 40 99 90 - Package Control Systems [Addendum #1]
- 40 99 90 SUPPLEMENT – Ozone System PLC I/O List [Addendum #1]
- 44 44 56 - Ozone System—General [Addendum #1]
- 44 44 56.07 - Off-Gas Ozone Destruct System
- 44 44 56.10 - Ozone System Instruments [Addendum #1]
- 44 44 56.10 SUPPLEMENNT – Ozone Instrument List [Addendum #1]
- 44 44 56.11 - Ozone System Supplier's Services
- Drawings
 - 01-G-101 - COVER SHEET AND DRAWING INDEX
 - 01-G-103 - ABBREVIATIONS 1
 - 01-G-104 - ABBREVIATIONS 2
 - 01-G-112 - INSTRUMENTATION AND CONTROL - LEGEND - SHEET 1
 - 01-G-113 - INSTRUMENTATION AND CONTROL - LEGEND - SHEET 2
 - 08-1-101 - P&ID - LIQUID OXYGEN STORAGE AND FEED
 - 08-1-102 - P&ID - OZONE GENERATION
 - 08-1-103 - P&ID - OZONE NITROGEN BOOST SYSTEM
 - 08-1-104 - P&ID - OZONE GENERATION COOLING WATER SYSTEM
 - 08-1-105 - P&ID - OZONE INJECTION AND CONTACTOR - R1
 - 08-1-106 - P&ID - OZONE INJECTION AND CONTACTOR - R5
 - 08-1-107 - P&ID - REACTOR WATER PIPELINES
 - 08-1-108 - P&ID - OZONE OFF-GAS DESTRUCTION [Addendum #1]
 - 08-I-202 - I&C - OZONE CONTROL SYSTEM PROFINET BLOCK DIAGRAM [Addendum #1]

1.4 Specification Review

- Email between Joshua Kenedy (Jacobs) and Vito Ruvo (Veolia) / Dated November 26th, 2025
 - Confirmation that a panel-mounted Differential Temperature Controller for each Ozone Destruct Control Panel is not required.



2 ABBREVIATIONS

LOX	Liquid Oxygen
GOX	Gaseous Oxygen
LN2	Liquid Nitrogen
IGS / IGS+	Intelligent Gap System
MOCP	Master Ozone Control Panel
OIT	Operator Interface Terminal (aka LOI; Local Operator Interface)
P&ID	Process and Instrumentation Diagram
PLC	Programmable Logic Controller
PSU	Power Supply Unit
AESS	Applications Engineering System Supplier
OSS	Ozone System Supplier
OXSS	Oxygen System Supplier
BNM	Basin Nozzle Manifold.
CFD	Computational Fluid Dynamics
MTE	Mass Transfer Efficiency
SVI	Side-stream Venturi Injector



3 SCOPE OF SUPPLY – HIGH LEVEL

1. Oxygen Gas Source System	Not in scope
2. Oxygen Gas Header	Loose instrument
3. Supplemental Nitrogen Gas Source System	Not in scope
4. Supplemental Nitrogen Gas Header	Loose instruments
5. Ozone Generation System	Loose instruments, valves, and actuators
6. Ozone Generation Cooling System	Not in scope
7. Ozone Delivery System	Loose instruments, valves, and actuators
8. Ozone Dissolution System	Not in scope
8. Ozone Contacting and Off-Gassing System	Loose instruments
9. Ozone Destruct System	Loose instruments, valves, and actuators
	Panel back and side panels, automation hardware, and software
10. Ozone Control System	Panel back and side panels, automation hardware, and software
11. Ambient Ozone & Oxygen Monitors	Not in scope
12. Spare Parts & Tools	** See details
13. Engineering	** See details
14. Factory Testing	** See details
15. Field Services (Inspect, Start-Up, Training)	** See details
16. Options	<i>None at this time</i>



4 SCOPE OF SUPPLY - DETAILED

4.1 Oxygen Gas Header

Principle Specification Section(s): **44 44 56, 44 44 56.10, 44 44 56.11**

Specification Drawing(s): **08-I-101**

Veolia P&ID: **See highlighted P&ID for annotations and adaptations**

4.1.1 General

Gaseous oxygen will be conditioned and monitored upstream of the ozone generators

4.1.2 Skidded Equipment

None in scope

4.1.3 Loose Equipment

*			
QTY	DESCRIPTION	TAG NO.	ADDITIONAL DETAILS
1	Lot of loose parts		* Please review highlighted P&IDs and preliminary bill of materials (valves/actuators, instruments, equipment) for details on what individual components are being provided.

4.2 Supplemental Nitrogen Gas Header

Principle Specification Section(s): **44 44 56, 44 44 56.10, 44 44 56.11**

Specification Drawing(s): **08-I-103**

Veolia P&ID: **See highlighted P&ID for annotations and adaptations**

4.2.1 General

Part of the *existing* nitrogen generation skid, the Supplemental Nitrogen Gas Header is the pipe portion of the skid that is downstream of the desiccant dryer, equipped with monitoring instruments and control devices. It is the intermediate between the nitrogen gas source system and the gaseous oxygen (GOX) header.

4.2.2 Skidded & Pre-Assembled Equipment

None in scope

4.2.3 Loose Equipment

*			
QTY	DESCRIPTION	TAG NO.	ADDITIONAL DETAILS
1	Lot of loose parts		* Please review highlighted P&IDs and preliminary bill of materials (valves/actuators, instruments, equipment) for details on what individual components are being provided.

4.3 Ozone Generation System

Principle Specification Section(s): **40 99 90, 44 44 56, 44 44 56.10, 44 44 56.11**

Specification Drawing(s): **08-I-102**

Veolia P&ID: **See highlighted P&ID for annotations and adaptations**



4.3.1 General

Ozone (O₃) is a tri-atomic gas, obtained by the ionization of oxygen (O₂) by means of a high-voltage AC current applied between two electrodes separated by a gap through which the oxygen flows. The AC voltage is provided by the Power Supply Unit.

Gas at the generator discharge is a mixture of ozone and oxygen at a pre-set concentration.

4.3.2 Skidded & Pre-Assembled Equipment

None in scope

4.3.3 Loose Equipment

*			
QTY	DESCRIPTION	TAG NO.	ADDITIONAL DETAILS
1	Lot of loose parts		* Please review highlighted P&IDs and preliminary bill of materials (valves/actuators, instruments, equipment) for details on what individual components are being provided.

4.3.4 Modified Equipment

To meet the hardware and networking requirements of this project, the Power Supply Units that are being provided under a separate project will need to be adapted prior to delivery.

The following are the major modifications that will be applied:

*			
QTY	DESCRIPTION	TAG NO.	ADDITIONAL DETAILS
-2	Network Address Translation Router	CP-31001 CP-31002	Allen-Bradley; 1783-NATR
2	LAN Router ** Address conversion (NAT/NAPT)	CP-31001 CP-31002	Siemens; Simatic SCALANCE S615
2	Network Coupler	CP-31001 CP-31002	Siemens; Simatic PN/PN coupler for deterministic data exchange
-2	Operator Interface	CP-33001-OIT CP-33002-OIT	Siemens; Simatic HMI TP 900, Comfort Panel, 9" widescreen TFT display, 16M colors
2	Operator Interface	CP-33001-OIT CP-33002-OIT	Siemens; Simatic HMI MTP 1000, Unified Comfort Panel, 10.1" widescreen TFT display, 16M colors

4.4 Ozone Delivery System

Principle Specification Section(s): **44 44 56, 44 44 56.10, 44 44 56.11**

Specification Drawing(s): **08-I-105, 08-I-106**

Veolia P&ID: **See highlighted P&ID for annotations and adaptations**

4.4.1 General

The mechanism to carry the ozone-rich gas to the treatment process can vary depending on the dissolution system used. At a minimum, it will require a pipeline equipped with gas flow control capabilities. Additionally, the delivery system can require that the ozone-rich gas be pre-mixed into a small body of carrier water using an injection system, before being introduced to the treatment process.

For this project, two (2) individual gas pipelines, each provide ozone-rich gas to a dedicated pipeline contactor, often referred to as "reactor" (R1, R5).



The ozone system uses raw water pulled immediately upstream of the pipeline flash reactor (PFR) as the source water for the sidestream injection systems.

Ozone gas will be introduced into the water sidestream by use of side-stream pumps and venturi injectors. From the venturis, the side-stream ozonated water will travel to the mixing nozzles of the PFR.

Each gas pipeline will utilize two (2) venturi systems per dissolution system to deliver the ozone-enriched sidestream water to their respective PFR. The two (2) venturi systems will share three (3) sidestream water pumps, where any one pump can be used with any one venturi.

4.4.2 Skidded & Pre-Assembled Equipment

None in scope

4.4.3 Loose Components

*			
QTY	DESCRIPTION	TAG NO.	ADDITIONAL DETAILS
1	Lot of loose parts		* Please review highlighted P&IDs and preliminary bill of materials (valves/actuators, instruments, equipment) for details on what individual components are being provided.

4.5 Ozone Contacting and Off-Gassing System

Principle Specification Section(s): 40 99 90, 44 44 56.07, 44 44 56.10, 44 44 56.11

Specification Drawing(s): 08-I-107, 08-I-108

Veolia P&ID: See highlighted P&ID for annotations and adaptations

4.5.1 General

The contacting system, be it a pipeline or concrete structure, will provide sufficient contact time between ozone gas and water to achieve effective disinfection and oxidation.

For this project, two (2) pipeline contactors, often referred to as "reactor" (R1, R5) are used for both contacting and off-gassing.

4.5.2 Skidded & Pre-Assembled Equipment

None in scope

4.5.3 Loose Components

*			
QTY	DESCRIPTION	TAG NO.	ADDITIONAL DETAILS
1	Lot of loose parts		* Please review highlighted P&IDs and preliminary bill of materials (valves/actuators, instruments, equipment) for details on what individual components are being provided.

4.6 Ozone Destruct System

Principle Specification Section(s): 40 99 90, 44 44 56, 44 44 56.07, 44 44 56.10, 44 44 56.11

Specification Drawing(s): 08-I-107, 08-I-108

Veolia P&ID: See highlighted P&ID for annotations and adaptations



4.6.1 General

Excess gas containing both ozone and oxygen (called off-gas) will naturally rise above the water level of the contacting structure, which can result in the pressurization of the contact structure itself. To avoid that any of the ozone-rich gas escapes the structure, which has the potential for creating a hazardous environment, the off-gas is recuperated by means of a vacuum blower installed on a dedicated skid called the Ozone Destruct Unit, and this, via the off-gas pipe installed atop the contact structure. The result of using a vacuum blower to collect the ozone-rich gas is that the contactor is always under a slight vacuum when in operation.

Additional components are also required, such as a pre-heater (installed on the destruct skid) to condition the off-gas prior to it reaching the catalyst chamber, and the catalyst chamber itself, placed between the pre-heater and the blower, to neutralize the ozone in the gas.

4.6.2 Skidded & Pre-Assembled Equipment

*			
QTY	DESCRIPTION	TAG NO.	ADDITIONAL DETAILS
2	Ozone Destruct Control Panel Back Panel	CP-33001-BackPanel CP-33002-BackPanel	
2	Ozone Destruct Control Panel Side Panel	CP-33001-SidePanel CP-33002-SidePanel	

4.6.3 Loose Components

*			
QTY	DESCRIPTION	TAG NO.	ADDITIONAL DETAILS
2	Operator Interface	CP-33001-OIT CP-33002-OIT	Siemens; Simatic HMI MTP 1000, Unified Comfort Panel, 10.1" widescreen TFT display, 16M colors
2	Load of Catalyst Media	TNK-33251 TNK-33252	Manufacturer: CARUS
2	Complete set of gaskets	N/A	a. For all valves including those not being replaced as part of the project. b. Catalyst chamber cover
1	Lot of loose parts		* Please review highlighted P&IDs and preliminary bill of materials (valves/actuators, instruments, equipment) for details on what individual components are being provided.

4.6.4 Additional Information

Programming

The programming and configuration of both the PLC and OIT will follow Veolia Standard Programming Practices and Established Code Standards.

4.7 Ozone Control System

Principle Specification Section(s): **40 99 90, 44 44 56, 44 44 56.11**

Specification Drawing(s): **08-I-101, 08-I-102, 08-I-103, 08-I-104, 08-I-105, 08-I-106, 08-I-108**

Veolia P&ID: **See highlighted P&ID for annotations and adaptations**



4.7.1 General

The entire ozone system is monitored and controlled through two (2) existing panels; the main control panel known as the Master Ozone Control Panel (MOCP; CP-31000), and a remote I/O panel known as the Ozone Injection Control Panel (OICP; CP-32000).

The existing MOCP is equipped with redundant S7-400H series PLC processors and two (2) remote I/O racks. The two (2) remote I/O racks are connected to the redundant processors via a redundant ProfiBus network. The I/O modules within the racks are of the SIMATIC S7-300 series.

The existing OICP is equipped with two (2) remote I/O racks and a local operator interface. The two (2) remote I/O racks are connected to the redundant processors in MOCP via a redundant ProfiBus network. The I/O modules within the racks are of the SIMATIC S7-300 series.

4.7.2 Skidded & Pre-Assembled Equipment

*			
QTY	DESCRIPTION	TAG NO.	ADDITIONAL DETAILS
1	Master Ozone Control Panel Back Panel	CP-31000-BackPanel	
1	Ozone Injection Control Panel Back Panel	CP-33000-BackPanel	
1	Ozone Injection Control Panel Side Panel	CP-33000-SidePanel	

4.7.3 Loose Components

*			
QTY	DESCRIPTION	TAG NO.	ADDITIONAL DETAILS
2	Operator Interface	CP-33001-OIT CP-33002-OIT	Siemens; Simatic HMI MTP 1000, Unified Comfort Panel, 10.1" widescreen TFT display, 16M colors

4.7.4 Project Related Information

Master Ozone Control Panel - Retrofit

Once retrofitted, the MOCP will be equipped with redundant S7-1500H series PLC processors and two (2) remote I/O racks. The two (2) remote I/O racks are connected to the redundant processors via a redundant ProfiNet network. The I/O modules within the racks will be of the ET 200 SP HA series.

An operator interface will be supplied, providing local operator access to all functionalities as they relate to the ozone system, as well as the rest of the water treatment facility.

Ozone Injection Control Panel - Retrofit

The OICP will be equipped with two (2) remote I/O racks and a local operator interface. The two (2) remote I/O racks are connected to the redundant processors in MOCP via a redundant ProfiNet network. The I/O modules within the racks will be of the ET 200 SP HA series.

An operator interface will be supplied, providing local operator access to all functionalities as they relate to the ozone system, as well as the rest of the water treatment facility.

Programming

The programming and configuration of the PLC will follow Veolia Standard Programming Practices and Established Code Standards.

The programming and configuration of the operator interface will follow Veolia Standard Programming Practices and Established Code Standards in keeping with the programming in the corresponding PLC, while respecting the end-user's establish guidelines and standards relating to such things like button locations, alarm event windows, layers, and assets to name a few. Veolia will also respect and follow established User Hierarchy settings that will establish users access permissions (read only, process control changes, alarm reset, alarm disable, etc.).



4.7.5 Notable Features

The following are some of the notable features associated with a standard Veolia Ozone Control System:

- A. **Intelligent “Out of the Box” Control Strategies:** Veolia provides standard features with its ozone control systems that will:
 - a. Adapt to changing process demands through dynamic control algorithms
 - b. Adapt ozone production schemes by determining the appropriate ozone concentration when demands are below achievable thresholds
 - c. Maintain precise ozone dosage control
 - d. Provide appropriate life safety strategies
 - e. Integrate seamlessly with existing plant control systems
 - f. Minimize operator intervention through automated operation modes
 - g. Facilitate easy troubleshooting with comprehensive alarming strategies
 - h. Support multiple communication protocols for flexible integration

These features are designed to enhance the overall performance, efficiency, and reliability of the ozone production and delivery process while simplifying operation and maintenance for plant personnel

4.7.6 Project Specific Features

The new control system will retain the following existing principal functionalities:

- Treatment Plant Control
- Emergency Plant Operation
- Emergency Shutdown Systems
- Automatic Flow-Pacing Dose Mode
- Automatic “CT Trim” mode

The following are some of the new functions being introduced to the ozone control system per the specification:

- A. **“Residual Mode”:** An ozone residual and water flow-paced automatic control strategy driven by a closed-loop controller. The control loop will make automatic increasing or decreasing adjustments to the initial ozone dosage set point, which will result in a change in either gas flow rates, ozone concentration or both to achieve equilibrium between the operator-entered residual dissolved ozone set point and the actual residual ozone readings on each reactor.
- B. **Ambient Low Oxygen Alarms (typical of 3)**
 - a. Ozone Generator Room - AIT-31011
 - b. Ozone Injection Room - AIT-32011
 - c. Ozone Destruct Room - AIT-33411
- C. **Ambient High-High Oxygen Alarms (typical of 2)**
 - a. Ozone Injection Room – AIT-32011 (*change in source*)
 - b. Ozone Destruct Room – AIT-33411 (*change in source*)
- D. **Operator selectable redundant ozone gas flowmeter.** The process value used by each of the closed-loop gas flow controllers, which maintain ozone flowrates for each ozone delivery lines, will be sourced from two possible redundant gas flowmeter. Selecting the flowmeter to be used will be a manual operator function.
- E. **Reactor #1 Ozone Delivery Gas Line Gas Flow Alarms (typical of 2)**
 - a. Low Gas Flow Alarm



- b. Low-Low Gas Flow Alarm
- F. Reactor #1 6" Injector Motive Water Pump #3:** A third Motive Water Pump will be added, sized to delivery motive water to either of the two (2) existing 6" injectors.
 - a. Priority selection between three (3) pumps
 - b. Automatic switch-over to next available pump upon failure
 - c. **NOTE:** The 4" injector and all associated instruments, valves, pumps, etc. will be removed entirely.
- G. Reactor #5 Ozone Delivery Gas Line Gas Flow Alarms (typical of 2)**
 - a. Low Gas Flow Alarm
 - b. Low-Low Gas Flow Alarm
- H. Reactor #5 6" Injector Motive Water Pump #3:** A third Motive Water Pump will be added, sized to delivery motive water to either of the two (2) existing 6" injectors.
 - a. Priority selection between three (3) pumps
 - b. Automatic switch-over to next available pump upon failure
 - c. **NOTE:** The 4" injector and all associated instruments, valves, pumps, etc. will be removed entirely.
- I. GOX Header Dew Point Alarms**
 - a. High GOX Dew Point Alarm
 - b. High-High GOX Dew Point Alarm

NOTE: It is believed that this is not a new alarm, but ones that are already configured in the existing system
- J. Nitrogen Dew Point Alarms**
 - a. High GOX Dew Point Alarm
 - b. High-High GOX Dew Point Alarm

NOTE: It is believed that this is not a new alarm, but ones that are already configured in the existing system
- K. Differential Pressure across Cooling Water Raw Water Strainer Alarms (typical of 2)**
 - a. High Differential Pressure Alarm
 - b. High-High Differential Pressure Alarm
- L. Automatic/Manual flushing of the cooling water raw water strainer packages (typical of 2)**

4.8 Spare Parts & Tools

Principle Specification Section(s): **40 99 90, 44 44 56.07, 44 44 56.10**

Specification Drawing(s): **Not applicable**

Veolia P&ID: **Not applicable**

4.8.1 Extra Materials – Specification 40 99 90, paragraph 1.06.A

QTY	DESCRIPTION
1	Lot of fuses 100 %, minimum of five (5), of each type supplied per the scope of this project
1	Lot of surge suppressors 20%, minimum of one (1), of each type supplied per the scope of this project



4.8.2 Extra Material – Specification 44 44 56.07, paragraph 1.05.A

QTY	DESCRIPTION
2	100% of fuses for Ozone Destruct Unit

4.9 Engineering

4.9.1 Team

Our strategically positioned engineering teams execute seamlessly across two key locations: our Leonia, New Jersey office in the United States and our Montreal, Quebec office in Canada.

This dual-location approach provides numerous benefits for our clients:

- **Expanded Expertise:** By leveraging talent pools from both countries in North America, we ensure access to a diverse range of skilled engineers and specialists. This allows us to tackle a wider variety of projects with precision and innovation.
- **Cross-Border Capabilities:** Our presence in both the U.S. and Canada positions us uniquely to handle projects with international components, understanding regulations and standards on both sides of the border.
- **Cultural Diversity:** The multicultural environments of New Jersey and Montreal infuse our work with varied perspectives, fostering creativity and problem-solving.
- **Language Versatility:** With a bilingual team (English and French), we can effectively communicate with a broader range of clients and partners.
- **Economic Flexibility:** Our dual locations allow us to optimize costs and resources, potentially offering more competitive pricing for our clients.
- **Local Presence, Global Reach:** While maintaining a strong local presence in two key markets, our dual-office setup also positions us for broader North American and international projects.

Whether you're based in the United States, Canada, or anywhere else in the world, our Leonia and Montreal offices work in perfect synergy to deliver top-tier engineering services tailored to your specific needs.

4.9.2 Standard Service

Engineering will be in accordance with the requirements and deliverables set forth by this proposal. Veolia will provide all necessary design, installation and operating information for equipment provided by in this proposal. Veolia will coordinate and review other equipment items associated with the ozone system but will not be responsible for the design, installation and operation of equipment and systems supplied by others.

Engineering information by Veolia for equipment that it supplies shall consist of:

- System Integration Engineering
- General equipment orientation and dimensional drawings for all equipment and system components as provided by Veolia.
- Electrical schematics, panel layouts and interconnecting terminal block drawings for all controls and instruments supplied (as applicable)
- Office and field coordination with the general and subcontractors.
- Equipment layout and data including manufacturer, model, power requirements, capacity, and materials of construction.
- Storage, handling, and erection requirements
- Operations and Maintenance Manuals

4.9.3 Factory Testing (FT) Protocol (unwitnessed/witnessed)

Document describing the tasks associated with the verification and testing of the supplied equipment to certify that all is properly manufactured, assembled, configured, pre-testing and is functional in accordance with the project specification and the end user's expectations.



- Visual Inspection
- Point-To-Point
- Power-Up
- Communication verification
- I/O Check (local to equipment)
- Functional validation

4.9.4 Operational Readiness Testing (ORT) Protocol

Document describing the tasks associated with the verification and testing of the supplied equipment to certify that all is properly installed and is connected in accordance with installation documents.

- Visual Inspection
- Power-Up
- Communication verification
- I/O Checkout (end-to-end; field to PLC/OIT/SCADA)
- Rudimentary/basic functional validation

4.9.5 Functional Validation Testing (FVT) Protocol

Document describing the tasks associated with the verification and testing of the supplied equipment to certify that all is functioning as per design and as specified, in accordance with the project functional specification and the end user's expectations.

- Preliminary logic validation
- Pre-operational functional validation
- Operational functional validation

4.9.6 Coordination Meetings and Workshops

*Principle Specification Section(s): **40 99 90, 44 44 56.11***

- **Software Coordination Workshops**
 - o Veolia will attend up to three (3) Application Software Development Workshops to ensure conformance with Project-wide application software requirements.
 - o The first will be virtual, where the Process Instrumentation and Control (PIC) Integrator will hold an online meeting to review the existing project organization, and methodologies to be used for new development.
 - o The second will be in person, to coordinate with Owner, engineer, and plant's software integrator to ensure software controls interface requirements are understood and necessary information is exchanged. Topics that will be covered are, but not limited to, those listed in **44 44 56.11, paragraph 1.05.C.**
 - o The third will be virtual, where Veolia will present advancements made with software development, in anticipation of the Software Submittal. This will provide Veolia with beneficial feedbacks prior to Factory Testing.

4.9.7 Specified and Specific Service

- **Process Control Narrative:** Also known as the "Functional Description Specification". Will detail features, functions, and operator interfacing of the control system, without specifying how it will be implemented. It will include the objectives of the control system and its sub-systems, input and output required by both the field equipment and the operator, operational sequences and logic, alarm and interlock conditions, safety requirements and emergency shutdown procedures, and integration points with other systems.



4.10 Factory Testing

4.10.1 Location

All of Veolia's validation work will be accomplished at a location that will provide ease of access to all parties. The facility will be ideally situated to accommodate witnessed testing by the end-user, engineer, and/or general contractor.

4.10.2 Unwitnessed Factory Testing

Principle Specification Section(s): 44 44 56.11

Specification Drawing(s): Not applicable

Veolia P&ID: Not applicable

Veolia places a strong emphasis on rigorous testing and validation of all equipment before it leaves our facility. This commitment to quality assurance ensures that every system we ship meets our high standards of performance and reliability. Our comprehensive testing procedures involve thorough functional checks and simulation of operational conditions. This meticulous approach not only minimizes the risk of issues arising during installation and commissioning at the customer's site but also demonstrates our dedication to delivering products that perform as promised from day one. By investing time and resources in pre-shipment testing, we aim to streamline on-site installation, reduce potential downtime, and ultimately provide our customers with confidence in the equipment they receive.

Specific to this project

Veolia will affectively validate the programming of all supplied PLCs, the OITs, and the ozone system's portion of the SCADA (used on the MOCP and OICP). This includes a comprehensive series of tests such as functional testing of all components, simulation of various operational scenarios, verification of control system logic and responses, and final documentation review and completeness check.

All factory test procedure and signed checklists are submitted following completion of the Unwitnessed Factory Test.

4.10.3 Witnessed Factory Testing

Principle Specification Section(s): 44 44 56.07, 44 44 56.11

Specification Drawing(s): Not applicable

Veolia P&ID: Not applicable

Time has been allocated for remote witnessing the operations and functionalities of the new ozone control system.

At the discretion of and the to the owner and engineer, factory testing may be witnessed in place.

The following activities are associated with the witnessed testing and demonstration:

- Final review in runtime form of the Ozone System SCADA
- Demonstration of implemented features
- Simulation of select portions of ozone system functionalities

4.11 Field Services (Meetings, Inspections, Start-Up, Training)

Principle Specification Section(s): 40 99 90, 44 44 56.11

Specification Drawing(s): Not applicable

Veolia P&ID: Not applicable

Definition of "calendar-days" is Monday through Friday.

See section "**Conditions of Field Service**" of this proposal for definitions of WORK, TRAVEL and STANDBY TIME and the rates that apply to each. Please note the three (3) applicable rates that would apply if service were required in addition to the times allotted by the base proposal.

The following field services will be provided under this scope title:



4.11.1 Site Survey

Principle Specification Section(s): Not applicable

- Veolia has allotted for time on site to trace the system and correlate the most recent documentation (P&ID, panel drawings, electrical drawings) with the actual installation.
- The objective will be to make sure that any information needed to proceed with the project is accurate and properly documented, minimizing any errors that would affect the deliverables set forth.

TOTAL Man-days	TOTAL Calendar-days	TOTAL Man-hours	TRIPS
*	2	*	1

- Any identifiable differences found between the Veolia-managed documentation and the physical installation will be marked-up (redlined) and updated by Veolia as part of this project.

4.11.2 Commissioning & Start-Up

Principle Specification Section(s): 44 44 56, 44 44 56.11

- Final Inspection, Operational Readiness Testing, Commissioning, Functional Validation Testing
- Classroom and hands-on training

Veolia anticipates that the activities listed will be accomplished in multiple phases.

TOTAL Man-days	TOTAL Calendar-days	TOTAL Man-hours	TRIPS
*	*	*	Multiple

Veolia has identified at least three (3) unique time periods when different activities requiring Veolia's presence would take place:

- **Pre Ozone Outage Window Period:**
 - o Period leading up to the "Ozone Outage Window".
 - o Period during which one (1) ozone destruct will be placed out of service and fully retrofitted. Once ready, Veolia will be able to commission and start-up the unit, in local, ready for use during and after the "Ozone Outage Window"
 - o Period during which one (1) ozone generator, and associated Power Supply Unit, will be placed out of service and fully retrofitted (new PSU, cleaning of vessel, etc.). Once ready, Veolia will be able to accomplish ORT-related tasks rendering the unit ready for commissioning and start-up during and after the "Ozone Outage Window"
- **Ozone Outage Window:**
 - o Window will be limited to eight (8) weeks, from January 4, 2027, to March 1, 2027.
 - o Period during which the ozone system will be shutdown for the demolition, installation, testing, and integration of the back and side panels of the Ozone Master Control Panel and Ozone Injection Panel.
 - o A return to service of a minimum of one ozone generator, one reactor train, and one ozone destruct by March 1, 2027.
- **Post Ozone Outage Restart:**
 - o Period following the successful restart of half of the ozone system (one generator, one reactor, one destruct, etc).
 - o Period during which the ozone system will remain in operation, while the equipment of the second half of the ozone system (second ozone generator, power supply unit, reactor, ozone destruct unit, etc.) are demoed, retrofitted, installed, tested, and integrated



5 WARRANTY

*Principle Specification Section(s): **44 44 56.11***

Veolia shall provide the following warranties for the equipment provided under this proposal:

- Twelve (12) months following successful Start-Up/Commissioning or eighteen (18) months following delivery, whichever comes first.
- Warranty will cover parts/components
- Warranty will not cover labor/service costs

NOTE: The above stipulation complements item e) of paragraph 6 of the “General Terms and Conditions of Sale”.



6 CLARIFICATIONS

1. SCADA Development Scope

Specification Section(s): 40 99 90

Specification Drawing(s): Not applicable

As explained by Jordan Stead from S&B Inc., whom Veolia will be recognizing for the time being as the Process Instrumentation and Control (PIC) Integrator for this project, Veolia will be provided with a “seed” project. It will reflect the needed organization of the existing project so that the PIC Integrator can later import the Veolia development easily. The Seed project will have a dedicated alarm group for this new generation of Ozone system, its own dedicated folder of ozone “archive” tags, a base screen demonstrating pixel size to work with, a basic trend window, and alarm window controller.

The PIC Integrator will be responsible for importing/merging the Veolia developed SCADA package into the existing facility SCADA package. Veolia will be available during this process as needed.

In summary, Veolia will not receive the complete SCADA of the facility, but a stripped-down version, containing little-to-no tags, with pre-configured options, pre-configured settings, and screen examples that will allow Veolia to develop the ozone system portion inline with the client’s existing system, meeting expectations and needs.

2. Off-Gas Ozone Destruct System – Extra Materials

Specification Section(s): 44 44 56.07 paragraph 1.05.A.2

Specification Drawing(s): Not applicable

Note that there are no special tools required for dismantling equipment.

3. Off-Gas Ozone Destruct System – Source Quality Control

Specification Section(s): 44 44 56.07 paragraph 2.05.B

Specification Drawing(s): Not applicable

Note that there are no skids being provided in Veolia’s scope, only instruments, valves, and equipment which will be provided loose, installed on the existing skids on-site by others. Factory testing of “All skid-mounted equipment” would not apply.

Similarly, witnessed factory testing by the owner and/or engineer would also not apply, specifically for “All skid-mounted equipment”.

Witness testing of the ozone destruct control panels’ back and side panels would be possible.

4. New signals and logic for AIT-33411

Specification Section(s): 40 99 90 paragraph 1.04.C, 40 99 90 SUPPLEMENT Ozone System PLC I/O List

Specification Drawing(s): 08-I-108

There is no mention in the specification for providing two (2) new digital signals into PLC-33001 connected to AIT-33411, representing LOW AMBIENT OXYGEN and HIGH AMBIENT OXYGEN.

Veolia’s records do not show that these signals were part of the original system.

Veolia has included the addition of these signals into its scope of supply (panel drawings, I/O list, etc., logic programming, etc.).

5. Ozone Destruct Unit Air Inlet Valve

Specification Section(s): 44 44 56.07 paragraph 1.03.B

Specification Drawing(s): 08-I-108

The air inlet valve is an existing device on the ozone destruct unit. Per the existing ozone destruct unit, the pipe on which the valve is installed taps into the off-gas inlet pipe upstream of the preheater.

It is Veolia’s understanding that this will not be changed.

6. Ozone Destruct Unit Catalyst Discharge Temperature Indicator

Specification Section(s): 44 44 56.10 SUPPLEMENT “Instrument List”



Specification Drawing(s): 08-I-108

The temperature indicator downstream of the catalyst chamber, upstream of the blower is shown on the P&ID as "Provided by the OSS" while the specification does not list the instrument within the "Instrument List".

Veolia has included the temperature indicator (for both destruct units).

7. Dew point alarm set point entry

Specification Section(s): 40 99 99 paragraph 1.04.C.3, .4

Specification Drawing(s): Not applicable

Both the GOX and NITROGEN dew point readings are critical process values that are used by the control system to potentially restrict applying power to the ozone vessel when the respective gas qualities do not meet the requirements set forth. Applying power to an ozone generator vessel while gas dew point is inadequate will ultimately foul the ozone generator vessel, decreasing its performance and subsequently requiring it to be cleaned.

For this reason, we discourage the practice of allowing the dew point alarm set points to be changed via an operator interface and would prefer these settings to be hard coded.

8. General – Performance Testing

Specification Section(s): 44 44 56.07, paragraph 1.02.A.1, 44 44 56, paragraph 1.04.D

Specification Drawing(s): Not applicable

The only equipment being modified under this project that would require performance testing are the Ozone Destruct Units given that their respective heaters, blowers, and catalyst media are being replaced.

Final Acceptance by the owner of this project should not be dependent on the successful completion of the Performance Testing of the Ozone Generators and their new Power Supply Units, even though it is requested that this Performance Test occur after the proper installation and start-up of the equipment related to this project (**44 44 56, paragraph 1.04.D**)

This project will be an amendment to the PSU REPLACEMENT project, and as such, both schedules will be merged, and timing of both "project" will be accommodated. Conditions for Final Acceptance of both "projects" will overlap as a result.

9. Ozone Destruct Preheater Differential Temperature Controller

Specification Section(s): 44 44 56.07 paragraph 2.02.B.2,

Specification Drawing(s): 08-I-108

The existing ozone destruct unit was provided with its preheater differential temperature controller as an integrated PLC function and not as a physical panel-mounted controller separate to the local PLC.

Veolia understands that the requirement set by the specification to provide an external independent panel-mounted device was a result of a misinterpretation of what is existing, and that Veolia will not be required to provide an external device for controlling the differential temperature across the preheater.

10. ProfiBus DP Communication Capability

Specification Section(s): 44 44 56.11, paragraph 1.08.C.1.e.1)

Specification Drawing(s): 08-I-202 (content replaced with content of 08-I-203)

Since the timing of both this project and the "PSU Replacement" project (presently in execution by Veolia) will align as far as installation, integration, and commissioning, the interim period where the existing ProfiBus DP network would have been kept operational will no longer apply since the ProfiNet network will be fully installed by the time start-up and commissioning will commence.

This was confirmed via Addendum #1, where changes were applied to other portions of the specification in response to the change in requirements, but omitted to apply the necessary change to this paragraph.

Veolia understands that this was an unintentional oversight, and that Veolia will not be required to provide any hardware or services relating to ProfiBus networking.

11. Extra Material (Spares)

Specification Section(s): 40 99 90 paragraph 1.06.A



Specification Drawing(s): Not applicable

Veolia's scope is to provide replacement back and side panels, which do not include selector switches, buttons, or indicating lights. As a result, Veolia would not be required to include any spares as defined in items 1 and 2.

12. R1 Capability for Standalone PLC & Components

Specification Section(s): 40 99 90 paragraph 2.04.L.7.c

Specification Drawing(s): 08-I-202

~~Achieving R1 redundancy functionality on the ProfiNet network is being achieved in panels that are outside of Veolia's scope of supply (COMM-31000, COMM-33000) as depicted on the ProfiNet Block Diagram (08-I-202).~~

~~Veolia believes that this was a misinterpretation of the networking architecture, and that the requirement would not apply to Veolia's scope of supply.~~

Any required components needed to achieve R1 redundancy functionality on the ProfiNet network are being provided for both the Ozone Destruct Panels (CP-33001, CP-33002), which are part of this project, and the Ozone Generator Control Panels (CP-31001, CP-31002), which are part of an existing project but that will need to be adapted in order to meet the latest project specification.

13. Spare Parts Required for Proper Maintenance

Specification Section(s): 44 44 56.10 paragraph 2.12.A

Specification Drawing(s): Not applicable

Since no period was referenced, Veolia has interpreted the passage as applicable to one (1) year of operation. With that in mind, Veolia has determined that periodic repair, adjustment, or calibration will not be required during the first year of operation following final acceptance. As a result, Veolia has not included any special tools, instruments, and accessories required for proper maintenance at this time.

14. Schedule – Ozone Outage Window

Specification Section(s): 44 44 56 paragraph 1.05.B

Specification Drawing(s): Not applicable

The following was listed as work that will be accomplished prior to the "Ozone Outage Window".

- a. Retrofitting one Ozone Generator Unit, by demoing and installing the new Power Supply Unit, cleaning and reconditioning the vessel, and replacing select instruments, valves and components as per the scope of this project.
- b. Retrofitting one Ozone Destruct Unit, by replacing the back and side panels of the control cabinet, installing the new operator interface, replacing the catalyst media, and replacing select instruments, valves and components as per the scope of this project.
- c. Replacing select-instruments, valves and components throughout the ozone system that can be kept off-line for an extended period of time.
- d. Adding new equipment, such as motive water pump(s) and new gas lines
- e. Any preparatory work relating to the ProfiNet network.

As a result, the eight (8) week "Ozone Outage Window" would be dedicated solely to the CONTROL SYSTEM replacement and the start-up of one train, which will include all the equipment mentioned previously.

15. Schedule - Delivery

Specification Section(s): 44 44 56 paragraph 1.05.A

Specification Drawing(s): Not applicable

As discussed with the engineer, Veolia believes that delivery of all equipment (implied) by September 1st 2026 will not be attainable. This is based on both Veolia's existing workload as well as the extensive requirements set forth by the specifications of this project.

Given the project's extensive scope, certain deliverables, such as the MOCP and OICP control back and side panels, will require additional lead times before arriving on site and this, to ensure they meet all specified requirements, such as the completion of the extensive factory testing.



We note that the project incorporates a phased installation schedule, and we propose leveraging this approach to optimize our delivery timeline. Veolia is committed to coordinating our deliveries to align with each installation phase, ensuring that equipment and components arrive precisely when needed. This strategy will support the overall project schedule while maintaining the quality and thoroughness expected by all parties.



7 RECOMMENDATIONS

None at this time.



8 DEVIATIONS / EXCLUSIONS

None at this time



9 SCHEDULE / TIMEFRAME

The following remains to be finalized.

- Order approved, signed, and returned: TBD
- Completion of Site Survey: 4 to 6 weeks following approved order
- Submittal of detailed engineering: 8 to 12 weeks following Completion of Site Survey
- Fabrication/Purchasing, testing: TBD
- Delivery to site:
 - o Package #1 16 to 18 weeks following Submittal Approval
 - Valves, actuators, instruments, blowers, heaters, ODCP back+side panels
 - o Package #2 20 to 22 weeks following Submittal Approval
 - SCADA Configuration, MOCP back panel, OICP back+side panels
- Commissioning, Start-Up, Training
 - o Pre Ozone Outage Window Period Prior to Scheduled Outage / Following First Installation Phase
 - o Ozone Outage Window During Scheduled Outage
 - o Post Ozone Outage Restart Following Second Installation Phase



10 EXCLUSIONS TO Veolia SCOPE OF SUPPLY

The following are excluded from the Veolia offer and will not be part of the Veolia scope of supply. These will need to be provided by others:

10.1 Generalized Work

The following items are not included in the proposed selling price and will be by others unless specifically called for in the body of this proposal:

- Removal and disposal of the existing equipment, and any other components being removed and demolished for replacement as part of this project
- Installation of the new equipment or any other component, both mechanical and electrical
- Equipment unloading, storage or erection.
- Interconnecting and intra-connecting electrical wiring except in skid mounted packaged equipment.
- Interconnecting and intra-connecting oxygen, ozone or water piping and manual valves between the oxygen system components, ozone system components, equipment skids, contactors or ozone destruct system components except as noted.
- Wall sleeves and fittings.
- HVAC.
- Control wiring or piping.
- Insulation on ozone generators, cooling water piping, ozone destructors or other hot or cold surfaces (unless as noted in this proposal elsewhere)
- Air, ozone, liquid oxygen, gaseous oxygen, or water piping not on skids
- Anchor bolts
- Instruments and valves except as noted.
- Instrument air, instrument tubing or fittings
- Design, programming, testing, or commissioning of any Control Systems other than those provided by Veolia, as described in previous sections.
- Power wiring and conduit, except on equipment skids
- Motor control center and local disconnects
- Field calibration of instruments not provided by Veolia
- Contact Chamber leakage testing
- Design of equipment not furnished by Veolia
- Cost for Power, Water or Liquid Oxygen (LOX) for commissioning and testing of equipment on site.



11 GENERAL

11.1 Shop Testing of Equipment

The equipment described in this proposal will be, where possible and required, functionally tested at the factory prior to shipment.

11.2 Design

The equipment described in this proposal will be of manufacturer's standard design and, where shipping tolerances require, will be shipped knocked down for installation in the field by others.

11.3 Scope - Material

The equipment to be furnished by VEOLIA will include only those major equipment items normally manufactured or supplied by VEOLIA as specifically listed in the equipment section of this proposal. Other items required to complete installation such as, but not limited to, wiring, conduit, starters, insulation, finish coats of paint, and pipe and fittings external to the major equipment components, will be done by others unless otherwise specified herein.

11.4 Scope - Services

This proposal does not include any expense for unloading, storage, erection, or supervision of erection.



12 Conditions of Field Service

If this Contract does not include Field Service or if Purchaser requires such service in addition to that included in this Contract, Purchaser may purchase from Veolia such Field Service or technical advice during installation or start up of the Products, in which case Purchaser agrees to pay Veolia for Work Time, Travel Time and Standby Time based on (1) Veolia's "per diem" rates in effect at the time the service is performed; (2) the expenses of each Veolia employee so furnished; and (3) the terms and conditions under which such service is performed.

"PER DIEM" CHARGES FOR SERVICE

The following rates are currently in effect. They are subject to change by Veolia and are based on the definitions below. These rates are for domestic service only. Rates for service outside the Continental United States will be quoted upon request.

Classification of Serviceman	Straight Time Rate		
STANDARD SERVICE	\$ 1,490.00 USD	Per	day
PROGRAMMING SERVICE	\$ 1,500.00 USD	Per	day

TIME DEFINITIONS

(a) Work Time - shall include all hours that Veolia service personnel are on Purchaser's job site, either working or ready for work, and shall be payable at the applicable specified rates.

(b) Travel Time - shall include the time spent by Veolia service personnel in traveling between their customary headquarters and Purchaser's job site and in returning (including travel occurring on Saturdays, Sundays and holidays) up to a maximum of eight (8) hours chargeable time for any given one-way trip. Travel Time shall be paid for at the applicable Straight Time Rate and shall not be cumulative with Work Time in determining Overtime.

(c) Standby Time - shall include all time (excluding Work Time) that Veolia service personnel are available for work at Purchaser's job site, whether on the job site or not, up to a maximum of eight (8) hours per day, between the hours of 7:00 a.m. and 6:00 p.m., Sunday through Saturday, including holidays if availability has been requested by Purchaser. Standby Time shall be paid for at the applicable Straight Time Rate; however, Standby Time preceded and/or followed by Work Time is cumulative in determining Overtime.

RATE DEFINITIONS

(a) Straight Time Rate - This rate shall be paid for Work Time, Standby Time or Travel Time on a regular schedule of eight (8) hours per day, Monday through Friday.

(b) Time and One-Half Rate - The rate of one and half (1-1/2) times the Straight Time Rate shall be paid for any Work Time or Standby Time in excess of eight (8) hours, but not exceeding sixteen (16) hours, per day, Monday through Friday, and for any Work Time or Standby Time on Saturdays, not to exceed sixteen (16) hours.

(c) Double Time Rate - The rate of twice the Straight Time rates shall be paid for time worked in excess of sixteen (16) hours per day, without a six (6) hour break, Monday through Saturday, and for all time worked on Sundays and holidays. Holidays shall be those observed in the locality where the work is to be performed.

CHARGES FOR EXPENSES

In addition to the "Per Diem" charges above, Purchaser shall pay Veolia for all the traveling and living expenses and all other expenses of each Veolia employee incidental to the work.

TERMS AND CONDITIONS

(1) Notification - Purchaser shall give Veolia at least two (2) weeks advance notice when ordering Field Service.

(2) Terms of Payment - Purchaser shall pay Veolia immediately upon receipt of invoices covering the time and expenses of Veolia's employees furnished for such services. OVERDUE PAYMENTS NOT RECEIVED BY VEOLIA WITHIN THIRTY (30) DAYS FROM DATE OF INVOICE SHALL BE SUBJECT TO FINANCE CHARGES AT THE RATE OF ONE AND ONE-HALF PERCENT (1-1/2%) PER MONTH.

(3) Time Sheets - Veolia employees shall present Purchaser at the end of each week or at the completion of the job if less than one (1) week, appropriate documents on which shall be indicated the number of hours spent and the estimated expense incurred on this work. Purchaser shall sign these documents in the place indicated, thus signifying approval of the time spent and estimated expense incurred on this work.

(4) Delays - If the work of an Veolia employee is postponed or suspended by Purchaser or is delayed or does not proceed with reasonable dispatch, due to no fault of Veolia, Veolia may withdraw such employee and return a serviceman to the job when needed and available; and any additional costs (including Travel Time and expenses) incurred by Veolia because of this shall be an additional charge to Purchaser.

(5) Limitation of Liability - Veolia in providing any Field Service hereunder, shall do so in an advisory capacity only and shall not be held responsible in any way for the acts, workmanship or omissions of the employees, contractors, sub-contractors or agents of Purchaser. VEOLIA SHALL NOT BE LIABLE IN ANY EVENT FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGE.



13 General Terms and Conditions of Sale – Sale of Capital Equipment

1. **Exclusive Terms and Conditions.** Together with any other terms the Parties agree to in writing, these General Terms and Conditions – together with the last proposal in order of time issued by the Seller – form the exclusive terms ("Agreement") whereby Buyer agrees to purchase, and Seller agrees to sell products and equipment (jointly "Equipment") and to provide advice, instruction and other services in connection with the sale of that Equipment ("Services"). If Buyer sends to Seller other terms and conditions to which Seller may not respond, including but not limited to those contained in Buyer's purchase order, such shall not apply. This Agreement may only be revised by a change order approved in writing by both Parties. All terms not defined herein shall be defined in Seller's proposal.
 2. **Equipment and Services.** The Equipment to be delivered and the Services to be provided shall be as set out in this Agreement. Unloading, handling, storage, installation, and operation of Buyer's systems or the Equipment are the responsibility of Buyer. Buyer shall not require or permit Seller's personnel to operate Buyer's systems or the Equipment at Buyer's site.
 3. **Prices and Payment.** Buyer shall pay Seller for the Equipment and Services in accordance with the payment schedule (as set forth in Seller's proposal or, if applicable, in any special conditions agreed to in writing by the Parties). Unless otherwise specified in writing, payment is due net thirty (30) days from the date of Seller's invoice. Seller may require a Letter of Credit or other payment guarantee, in which case the stated amount of the guarantee will be adjusted by Buyer in the event of any currency-based adjustment to prices or payment amounts per the Payment Schedule, and Buyer shall deliver the adjusted guarantee within five (5) days of request by Seller. Buyer agrees to reimburse Seller for collection costs, including 2% (two per cent) interest per month (not to exceed the maximum amount permitted by applicable law), should Buyer fail to timely pay. Buyer shall have no rights to make any deduction, retention, withholding or setoff relating to any payments due under this Agreement.
 4. **Taxes and Duties** Seller shall be responsible for all corporate taxes measured by net income due to performance of or payment for work under this Agreement ("Seller Taxes"). Buyer shall be responsible for all taxes, duties, fees, or other charges of any nature (including, but not limited to, consumption, gross receipts, import, property, sales, stamp, turnover, use, or value-added taxes, and all items of withholding, deficiency, penalty, addition to tax, interest, or assessment related thereto, imposed by any governmental authority on Buyer or Seller or its subcontractors) in relation to the Agreement or the performance of or payment for work under the Agreement other than Seller Taxes ("Buyer Taxes"). The Agreement prices do not include the amount of any Buyer Taxes. If Buyer deducts or withholds Buyer Taxes, Buyer shall pay additional amounts so that Seller receives the full Agreement price without reduction for Buyer Taxes. Buyer shall provide to Seller, within one month of payment, official receipts from the applicable governmental authority for deducted or withheld taxes. Buyer shall furnish Seller with evidence of tax exemption acceptable to taxing authorities if applicable, prior to execution of the Agreement by both Parties or issuance by the Seller of the order acceptance. Buyer's failure to provide evidence of exemption at time of order will relieve Seller of any obligation to refund taxes paid by Seller.
 5. **Delivery, Title, Risk of Loss.** Unless otherwise specified in this Agreement, Seller shall deliver all Equipment to Buyer FCA (Incoterms 2010) Seller's facility. The time for delivery of the Equipment to Buyer shall be specified in this Agreement. Seller's sole liability for any delay in delivery of the Equipment shall be as expressly set out in this Agreement. The place of delivery specified herein shall be firm and fixed, provided that Buyer may notify Seller no later than forty-five (45) days prior to the scheduled shipment date of the Equipment of an alternate point of delivery, Buyer shall compensate Seller for any additional cost in implementing the change. If any part of the Equipment cannot be delivered when ready due to any cause not attributable to Seller, Buyer shall designate a climate-controlled storage location, and Seller shall ship such Equipment to storage. Title and risk of loss shall thereupon pass to Buyer, and amounts payable to Seller upon delivery or shipment shall be paid by Buyer along with expenses incurred by Seller. Services provided herein shall be charged at the rate prevailing at the time of actual use and Buyer shall pay any increase, and Buyer shall pay directly all costs for storage and subsequent transportation. Failure by Buyer to take delivery of the Equipment shall be a material breach of this Agreement.
- Title and risk of loss to the Equipment shall be transferred from Seller to Buyer at the point of delivery upon handover in accordance with this Agreement. Title and risk of loss to the Services shall pass as they are performed.
6. **Warranties and Remedies.** Seller warrants that Equipment shall be delivered free from defects in material, workmanship and title and that Services shall be performed in a competent, diligent manner in accordance with any mutually agreed specifications. Seller's warranty does not cover the results of improper handling, storage, installation, commissioning, operation or maintenance of the Equipment by Buyer or third parties, repairs or alterations made by Buyer without Seller's written consent, influent water which does not comply with agreed parameters, or fair wear and tear.

Unless otherwise expressly provided in this **Proposal**, the foregoing warranties are valid for:

- (a) chemicals and Services, for six (6) months from their date of delivery or the provision of Services;
- (b) consumables, including filters and spiral wound membranes (other than spiral wound membranes for process treatment), the earlier of twelve (12) months from date of first use of fifteen (15) months from their date of delivery;
- (c) spiral wound membranes for process fluid treatment, ninety (90) days from their date of first use;
- (d) ultrafiltration membranes (ZW500, ZW700B, ZW1000, ZW1500), twelve (12) months from their date of delivery;
- (e) **Equipment other than chemicals and consumables, the earlier of, twelve (12) months from acceptance or eighteen (18) months from delivery of equipment;**
- (f) software, ninety (90) days from the date of receipt;
- (g) Equipment not manufactured by Seller, the warranty shall be the manufacturer's transferable warranty only,

Any claim for breach of these warranties must be promptly notified in writing, and Buyer shall make the defective item available to the Seller, or the claim will be void. Seller's sole responsibility and Buyer's exclusive remedy arising out of or relating to the Equipment or Services or any breach of these warranties is limited to repair at Seller's facility or (at Seller's option) replace at Seller's facility the defective item of Equipment, and re-perform defective Services. In performance of its obligations hereunder, Seller will not control the actual operation of either Buyer's systems or the Equipment at the Buyer's site.

Warranty repair, replacement or re-performance by Seller shall not extend or renew the applicable warranty period.



The warranties and remedies are conditioned upon (a) proper unloading, handling, storage, installation, use, operation, and maintenance of the Equipment and Buyer's facility and all related system in accordance with Seller's instructions and, in the absence, generally accepted industry practice, (b) Buyer keeping accurate and complete records of operation and maintenance during the warranty period and providing Seller access to those records, and (c) modification or repair of Equipment or Services only as authorized by Seller in writing. Failure to meet any such conditions renders the warranty null and void.

The Buyer will be entitled to assign to a subsequent owner of the Equipment the warranties of the Seller under this Agreement, provided that a prior written notification is sent to the Seller and the assignment agreement contains terms and conditions which provide the Seller with the protections of the warranties and limitations on liability contained in the Agreement. Subject to Buyer's compliance with the foregoing requirement, such warranty rights are expressly assignable by the Buyer to a subsequent owner of the Equipment. Except as provided herein, Buyer is not entitled to extend or transfer this warranty to any other party. The warranties and remedies set forth in this article are in lieu of and exclude all other warranties and remedies, statutory, express or implied, including any warranty of merchantability or of fitness for a particular purpose.

Unless otherwise expressly stipulated in this Agreement, Seller gives no warranty or guarantee as to process results or performance of the Equipment, including but not limited to product quality, flow, production, capacity, membrane life, chemical consumption, regulatory compliance or energy consumption.

7. General Indemnity. Seller shall indemnify and hold harmless Buyer from claims for physical damage to third party property or injury to persons, including death, to the extent caused by the negligence of Seller or its officers, agents, employees, and/or assigns while engaged in activities under this Agreement. Buyer shall likewise indemnify and hold harmless Seller from claims for physical damage to third party property or injury to persons, including death, to the extent caused by the negligence of the Buyer, its officers, agents, employees, and/or assigns. In the event such damage or injury is caused by the joint or concurrent negligence of Seller and Buyer, the loss shall be borne by each Party in proportion to its negligence. For the purposes of this article (i) "Third party" shall not include Buyer or any subsequent owner of the Equipment, their subsidiaries, parents, affiliates, agents, successors or assigns including any operation or maintenance contractor, or their insurer; and (ii) no portion of the Equipment is "third party property".

8. Compliance with Laws and Permits. All permits, authorisations, and licenses which are required to construct, install and/or operate Buyer's facility or equipment, to use the Equipment, or to manage and dispose of any wastes, discharges, and residues resulting from Buyer's use of the Equipment, shall be obtained and maintained by Buyer at Buyer's sole expense. Buyer is responsible for compliance with all laws and regulations applicable to the storage, use, handling, installation, maintenance, removal, registration, and labelling of all Equipment after delivery of the Equipment, as well as for the proper management and disposal of all wastes, discharges, and residues.

9. Buyer's Site Conditions. Buyer warrants that any data furnished to the Seller concerning conditions at Buyer's site (including but not limited to any existing Buyer facility, equipment or processes, influent water or other substances to be treated or measured with the Equipment) is accurate and complete, and the Seller reserves the right to utilize the most appropriate design compatible with generally accepted engineering practices, and to make changes in details of design, manufacture and arrangement of Equipment unless precluded by any limitations specified in this Agreement. Seller shall notify Buyer of (1) any conditions at Buyer's site which materially differ from those indicated in the data furnished by Buyer, (2) any previously unknown physical conditions at Buyer's site of an unusual nature, not revealed by previous investigations and differing from those ordinarily encountered in the type of work provided for in this Agreement, and (3) the presence of any Hazardous Materials (as defined below), the existence of a contaminated soil, unexploded ordinance, or archaeological remains. If such conditions cause an increase in Seller's cost or in the time required for the performance of Seller's obligations, Seller shall be entitled to an equitable adjustment in the Agreement price and an extension in the time for performance.

10. Hazardous Materials and Wastes. In the event that Seller encounters any Hazardous Materials (meaning toxic substances, hazardous substances, pollutants, contaminants, regulated wastes, or hazardous wastes as such terms may be defined or classified in any law, statute, directive, ordinance or regulations promulgated by any applicable governmental entity) at Buyer's site, other than Hazardous Materials introduced by Seller or that are otherwise the express responsibility of Seller under this Agreement, Buyer shall immediately take whatever precautions are required to legally eliminate such Hazardous Materials so that the Seller's work under this Agreement may safely proceed. At no time shall Seller be deemed to have taken title to or the responsibility for the management or disposal of any wastes, Hazardous Materials, influent water, any resultant product streams, wastewater streams, discharges, cleaning materials, or any other materials or substances processed by the Equipment or otherwise located at Buyer's site. Seller does not take responsibility for and hereby expressly disclaims responsibility for the characterization or disposal of wastes, Hazardous Materials, or for the identification, selection, or management of disposal facilities for any wastes.

11. Excusable Delays. Seller shall not be liable nor in breach or default of its obligations under this Agreement to the extent performance of such obligations is delayed or prevented, directly or indirectly, due to causes beyond the reasonable control of Seller, including, but not limited to: acts of God, natural disasters, unusually severe weather, fire, terrorism, war (declared or undeclared) epidemics, material shortages, insurrection, act (or omissions) of Buyer or Buyer's contractors/suppliers or agents, any act (or omission) by any governmental authority, strikes, labour disputes, transportation shortages, or vendor non-performance. The delivery or performance date shall be extended for a period equal to the time lost by reason of delay or non-performance, plus such additional time as may be necessary to overcome the effect of the delay or non-performance. If delivery or performance is delayed for a period exceeding 180 (one hundred and eighty) days, either Party may terminate this Agreement without further liability provided that Seller shall be paid an amount equal to that which would be payable to Seller under the article entitled "Termination". If Seller is delayed by any acts (or omissions) of Buyer, or by the prerequisite work of Buyer's other contractors or suppliers, Seller shall be entitled to an equitable adjustment in schedule, price and/or performance, as applicable.

12. Emergencies. If the safety of Seller's personnel is threatened or likely to be threatened by circumstances outside the reasonable control of Seller, including but not limited to war, armed conflict, civil unrest, riots, terrorism, kidnapping, presence of or exposure to hazardous materials, unsafe working conditions, or by the threat of such circumstances or a lack of adequate protections against such circumstances, Seller shall be entitled to take all necessary steps to ensure the security and safety of its personnel including the evacuation of personnel until such circumstances no longer apply. Any such occurrence shall be considered an excusable delay event. Buyer shall reasonably assist in the event of any such evacuation.

13. Confidentiality, Intellectual Property. Both Parties agree to keep confidential the other Party's proprietary non-public information, if any, which may be acquired in connection with this Agreement. Buyer will not, without Seller's advance written consent, subject Equipment to testing, analysis, or any type of reverse engineering. Seller retains all intellectual property rights including copyright which it has in all



drawings and data or other deliverables (including the Equipment) supplied or developed under this Agreement. Buyer agrees that it will not file patent applications on the Equipment or any development or enhancement of the Equipment, or of processes and methods of using the Equipment, without Seller's express prior written permission. Buyer further agrees that in any event any such patents will not be asserted against Seller or its other buyers based upon purchase and use of such Equipment. Seller grants to Buyer a non-exclusive, non-terminable, royalty free license to use the intellectual property embedded in Equipment delivered to and paid for by the Buyer, as well as any drawings, design or data delivered to and paid for by the Buyer, for the purposes of owning, financing, using, operating and maintaining the relevant Equipment at Buyer's site. Such license may only be assigned to a subsequent owner of the Equipment or to an operations and maintenance subcontractor. Such license does not extend to the re-creation of the Equipment or the manufacture of spares or consumables by Buyer or third parties.

Any software Seller owns and provides pursuant to this Agreement shall remain Seller's property. Seller provides to Buyer a limited, non-exclusive and terminable royalty free project-specific license to such software for the use, operation or maintenance at Buyer's site of any Equipment purchased hereunder to which the software is a necessary component. Buyer agrees not to copy, sub-license, translate, transfer, reverse engineer, or decode the software.

Seller shall indemnify and hold harmless Buyer from any rightful claim of any third party that any Equipment or Service infringe a patent in effect in the USA, an EU member state or country of delivery (provided there is a corresponding patent issued by the USA or an EU member state), or USA copyright or copyright registered in the country of delivery. If the Buyer notifies the Seller promptly of the receipt of any such claim, does not take any position adverse to the Seller regarding such claim and gives the Seller information, assistance and exclusive authority to settle and defend the claim, the Seller shall, at its own expense and choice, either (i) settle or defend the claim and pay all damages and costs awarded in it against the Buyer, or (ii) procure for the Buyer the right to continue using the Equipment or Service, or (iii) modify or replace the Equipment or Service so that it becomes non-infringing, or (iv) remove the infringing Equipment and refund the price. The above paragraph shall not apply to any misuse of Equipment or Equipment which is manufactured to the Buyer's design, or to alleged infringement arising from the combination, operation, or use of any Equipment or Services with other equipment or services when such combination is part of any allegedly infringing subject matter. The foregoing list of sub-sections (i), (ii), (iii), and (iv) and related terms state the entire liability of the Seller for intellectual property infringement by any Equipment or Service.

14. Limitations on Liability. Notwithstanding anything else contained in this Agreement, to the maximum extent permitted by law, and regardless of whether a claim is based in contract (including warranty or indemnity), extra-contractual liability, tort (including negligence or strict liability), statute, equity or any other legal theory:

- (a) THE TOTAL LIABILITY OF THE SELLER AND OF ITS INSURER FOR ALL CLAIMS ARISING OUT OF OR RELATING TO THE PERFORMANCE OR BREACH OF THIS AGREEMENT OR USE OF ANY EQUIPMENT OR SERVICES SHALL NOT EXCEED THE TOTAL PRICE PAID BY BUYER UNDER THIS AGREEMENT OR (IN THE CASE OF AN AGREEMENT FOR SERVICES WITH A TERM OF MORE THAN ONE YEAR) THE ANNUAL PRICE PAYABLE BY BUYER UNDER THIS AGREEMENT;
- (b) IN NO EVENT SHALL SELLER BE LIABLE FOR ANY LOSS OF PROFIT OR REVENUES, LOSS OF PRODUCTION, LOSS OF USE OF EQUIPMENT OR SERVICES OR ANY ASSOCIATED EQUIPMENT, INTERRUPTION OF BUSINESS, COST OF CAPITAL, COST OF REPLACEMENT WATER OR POWER, DOWNTIME COSTS, INCREASED OPERATING COSTS, CLAIMS OF BUYER'S CUSTOMERS FOR SUCH DAMAGES, OR FOR ANY SPECIAL, CONSEQUENTIAL, INCIDENTAL, INDIRECT, PUNITIVE OR EXEMPLARY DAMAGES;
- (c) SELLER'S LIABILITY SHALL END UPON EXPIRATION OF THE APPLICABLE WARRANTY PERIOD, PROVIDED THAT BUYER MAY CONTINUE TO ENFORCE A CLAIM FOR WHICH IT HAS GIVEN NOTICE PRIOR TO THAT DATE BY COMMENCING AN ACTION OR ARBITRATION, AS APPLICABLE UNDER THIS AGREEMENT, BEFORE EXPIRATION OF ANY STATUTE OF LIMITATIONS OR OTHER LEGAL TIME LIMITATION BUT IN NO EVENT – TO THE EXTENT PERMITTED BY APPLICABLE LAW – LATER THAN FIVE (5) MONTHS AFTER EXPIRATION OF SUCH WARRANTY PERIOD.

For the purposes of this article, "Seller" shall mean Seller, its affiliates, subcontractors and suppliers of any tier, and their respective agents and employees, individually or collectively. If Buyer is supplying Seller's Equipment or Services to a third party, Buyer shall require the third party to agree to be bound by this article. If Buyer does not obtain this agreement for Seller's benefit for any reason, Buyer shall indemnify and hold Seller harmless from all liability arising out of claims made by the third party in excess of the limitations and exclusion of this article.

15. Termination. This Agreement and any performance pursuant to it may be terminated by either Party, and the consequences of such termination shall be as set out in the next paragraph, if the other Party

- (a) becomes insolvent, makes an assignment for the benefit of its creditors, has a receiver or trustee appointed for the benefit of its creditors, or files for protection from creditors under any bankruptcy or insolvency laws; or
- (b) fails to make any payment when due or to establish any payment security required by this Agreement, or commits a material breach or defaults in its material obligations under this Agreement, and such default is not cured within thirty (30) days of written notice from the other Party.

Upon the termination of this Agreement by Buyer for cause (i) Seller shall reimburse Buyer the difference between that portion of the Agreement price allocable to the terminated scope and the actual amounts reasonably incurred by Buyer to complete that scope, and (ii) Buyer shall pay to Seller (a) the portion of the Agreement price allocable to Equipment completed, and (b) amounts for Services performed before the effective date of termination. Upon the termination of this Agreement by Seller for cause Buyer shall pay to Seller within thirty (30) days of receipt of invoice the price of all Equipment or Services delivered at the date of termination, plus an amount equal to all costs and expenses incurred in the engineering, sourcing, financing, procurement, manufacture, storage and transportation of the Equipment including materials, work in progress and any cancellation charges assessed against Seller by Seller's suppliers including reasonable overhead and profit on all such costs and expenses. Alternatively, if any schedule of termination payments has been agreed between the Parties, Buyer shall pay to Seller within thirty (30) days of receipt of invoice the amounts set out in that schedule.

Seller shall have the right to suspend performance upon written notice to Buyer in any case where Seller would have the right to terminate the Agreement under this article, without prejudice to Seller's right to terminate this Agreement for cause. Any cost incurred by Seller in accordance with any such suspension (including storage costs) shall be payable by Buyer upon submission of the Seller's invoice(s). Performance of the Seller's obligations shall be extended for a period of time reasonably necessary to overcome the effects of such suspension.



16. Governing Law, Dispute Resolution. This Agreement shall be governed by the substantive laws of the State of New York. In the event of a dispute concerning this Agreement, the complaining Party shall notify the other Party in writing thereof. Management level representatives of both Parties shall meet at an agreed location to attempt to resolve the dispute in good faith. Should the dispute not be resolved within thirty (30) days after such notice, the complaining Party shall seek remedies exclusively through arbitration. The seat of arbitration shall be the federal district court in Philadelphia, PA, and the rules of the arbitration will be the Commercial Arbitration Rules of the American Arbitration Association, which are incorporated by reference into this article.

Notwithstanding the foregoing, each Party shall have the right to commence an action or proceeding in a court of competent jurisdiction, subject to the terms of this Agreement, in order to seek and obtain a restraining order or injunction to enforce the confidentiality intellectual property provisions set forth in the first two paragraphs of article 13; nuclear use restrictions set forth in article 17, or to seek interim or conservatory measures not involving monetary damages.

17. No Nuclear Use. Equipment and Services sold by Seller are not intended for use in connection with any nuclear facility or activity, the Buyer warrants that it shall not use or permit others to use the Equipment or Services for such purposes, without the advance written consent of Seller. If, in breach of this, any such use occurs, Seller (and its parent, affiliates, suppliers and subcontractors) disclaims all liability for any nuclear or other damage, injury or contamination, and, in addition to any other rights of Seller, Buyer shall indemnify and hold Seller (and its parent, affiliates, suppliers and subcontractors) harmless against all such liability.

18. Export Control. Seller's obligations are conditioned upon Buyer's compliance with all applicable trade control laws and regulations including those of the United States, European Union, and France. Additionally, Buyer shall not sell, distribute, disclose, release or otherwise transfer any item or technical data provided under this Agreement to: (i) any country designated as a "State Sponsor of Terrorism" by the U.S. Department of State including, for this Agreement, the countries of North Korea (ii) any entity located in, or owned by an entity located in, a "State Sponsor of Terrorism" country, North Korea, (iii) the region of Crimea or (iv) any person or entity listed on the "Entity List" or "Denied Persons List", the list of "Specifically Designated Nationals and Blocked Persons" maintained by any other applicable prohibited party list. The Buyer hereby certifies that the work, technical data, software or other information or assistance furnished by the Seller or its Affiliates under this contract will not be used in the design, development, production, stockpiling or use of chemical, biological or nuclear weapons either by the Buyer or by any entity acting on the Buyer's behalf. The obligations of the parties to comply with all applicable trade control laws and regulations shall survive any termination or discharge of any other contract obligations.

19. Changes. Each Party may at any time propose changes in the schedule or scope of Equipment or Services. All changes to the Equipment or Services shall be subject to mutual agreement via a written change order or variation, which shall only become effective once signed by both Parties. The scope, Agreement price, schedule, and other provisions will be equitably adjusted to reflect additional costs or obligations incurred by Seller resulting from a change, after Seller's proposal date, in Buyer's site-specific requirements or procedures, or in industry specifications, codes, standards, applicable laws or regulations. It shall be acceptable and not considered a change if Seller delivers Equipment (including Equipment replacement under warranty) that bears a different, superseding or new part or version number compared to the part or version number listed in the Agreement, provided that in no circumstance shall this affect any other of Seller's obligations including those set forth in article 6.

20. Conflicts; Survival, Assignment. If there is any conflict between this Agreement and any written proposal or quotation provided by Seller, then the terms and conditions set forth in this Agreement shall prevail. If any term or condition of this Agreement or any accompanying terms and conditions are held invalid or illegal, then such terms and conditions shall be reformed to be made legal or valid, or deleted, but the remaining terms and conditions shall remain in full force and effect, and this Agreement shall be interpreted and implemented in a manner which best fulfills Parties' intended agreement. Those provisions which by their nature remain applicable after termination shall survive the termination of this Agreement for any reason. Seller may assign or novate its rights and obligations under the Agreement, in whole or in part, to any of its affiliates or may assign any of its accounts receivable under this Agreement to any party without Buyer's consent, and the Buyer hereby agrees, by signing this Agreement, to such assignment and to execute any document that may be necessary to complete Seller's assignment or novation. This Agreement shall not otherwise be assigned by either Party without the other Party's prior written consent, and any assignment without such consent shall be void.

Seller may (i) manufacture and source the Equipment and any part thereof globally in the country or countries of its choosing; and (ii) subcontract portions of the Services, so long as Seller remains responsible for such.

21. No third party beneficiary. Except as specifically set forth in the article entitled "Limitations on Liability" and "No Nuclear Use", this Agreement is not intended to, and does not, give to any person who is not a party to this Agreement any rights to enforce any provisions contained in this Agreement.

22. Entire Agreement. This Agreement embodies the entire agreement between Buyer and Seller and supersedes any previous documents, correspondence or agreements between them. No modification, amendment, revision, waiver, or other change shall be binding on either Party unless agreed in writing by the Party's authorized representative. Any oral or written representation, warranty, course of dealing, or trade usage not specified herein shall not be binding on either Party. Each Party agrees that it has not relied on, or been induced by, any representations of the other Party not contained in this Agreement.



Additional Clauses

*** **Insurance.** Buyer shall maintain all risk property and boiler and machinery breakdown insurance covering the full replacement value of Buyer's site, systems and related equipment, together with business interruption coverage, which includes a waiver of subrogation in favour of Seller and its affiliates. Prior to commencement of any work under this Agreement, and not less than annually thereafter during the term of this Agreement, Buyer shall deliver to Seller a certificate(s) of insurance and copy of waiver of subrogation endorsement evidencing that the foregoing insurance is in full force and effect. Seller shall maintain types and amounts of insurance against loss or damage and such other risks as customarily insured against by businesses whose operations are comparable to those of the Seller. Seller shall not be obliged to add Buyer or any other third party as an additional insured under Seller's insurance policies.

*** **Inspection and Factory Tests.** Seller will apply its normal quality control procedures in manufacturing the Equipment. Seller shall attempt to accommodate requests by Buyer to witness Seller's factory tests of Equipment, subject to appropriate access restrictions, if such witnessing can be arranged without delaying the work.

*** **Change control.** Buyer shall notify Seller immediately upon any change in ownership of more than fifty per cent (50%) of Buyer's voting rights or of any controlling interest in Buyer. If Buyer fails to do so or Seller objects to the change, Seller may (a) terminate the Agreement, (b) require Buyer to provide adequate assurance of performance (including but not limited to payment), and/or (c) put in place special controls regarding Seller's Confidential Information.



14 Selling Price

Item	Description	Price
1	Base Proposal	1,425,000 USD
TOTAL Selling Price:		1,425,000 USD ⁽¹⁾

(*) Note: No Sales Tax has been included. If required tax will be added to the selling price at the current rate when invoice is submitted.

SHIPPING TERMS	DAP to jobsite
TERMS OF PAYMENT	10% Upon approval of all detailed shop drawings 80% Upon delivery of all equipment to site 10% following installation inspection, commissioning, training and successful functional test, or one hundred twenty (120) days from shipment of equipment (whichever comes first)
VALIDITY	Sixty (60) days
BONDING	No Performance or Payment Bonds have been included in the above price
SERVICE	Field Service included in this Contract shall be provided for a period not to exceed [*] eight-hour man days provided in not more than [*] trips to check the completed installation by Purchaser, to place the Products in operation and to instruct Purchaser in their operation. Purchaser agrees to pay Veolia for any additional service days and/or trips in accordance with Veolia's standard service rates and conditions in effect at the time the service is performed. A minimum of one (1) full day of service will be charged to each trip. [*] See proposal details
SCHEDULE	Approval drawings and data shall be submitted approximately (see above) weeks after agreement to all terms, as evidenced by Veolia's receipt of this proposal, fully executed; or, in the event that Purchaser issues a Purchase Order, Veolia's receipt of fully executed letter agreement. Veolia estimates that shipment of the Products can be made in approximately (see above) weeks after Veolia has received from Purchaser final approval of all submittal drawings and data.
NOTES	1 Given the current geopolitical uncertainty related to tariffs and trade regulations, Veolia cannot estimate what impact such changes will have on tariff rates, pricing, and the availability of goods in the future. Veolia's proposal, reference 676385, does not yet take into account the impact that the aforementioned situation will have on costs, and as a result Veolia's pricing and supply chain. Although you have Veolia's assurance that we are taking proactive measures to mitigate any impacts caused by tariffs, Veolia does hereby reserve the right to adjust prices and schedule to reflect any impact incurred from tariffs at the time of execution and delivery.



PURCHASER'S ACCEPTANCE: BY ITS SIGNATURE BELOW OR ISSUANCE OF ANY PURCHASE ORDER OR OTHER DOCUMENT, NOTWITHSTANDING ANY STATEMENT OR PROVISION CONTAINED THEREIN TO THE CONTRARY, PURCHASER AGREES TO ALL THE CONDITIONS AND PROVISIONS OF THIS PROPOSAL AND CONTRACT. NO OFFER BY PURCHASER TO ALTER, AMEND, LIMIT OR DELETE ANY CONDITION OR PROVISION OF THIS PROPOSAL AND CONTRACT SHALL BE BINDING UPON VEOLIA UNLESS EXPRESSLY ACCEPTED IN WRITING BY VEOLIA.

PURCHASER'S ACCEPTANCE:

Name _____
Title _____

Company Name _____
Date: _____

Ship To:

SELLER

Name Vito Ruvo
Title Technical Sales Lead – Municipal Ozone

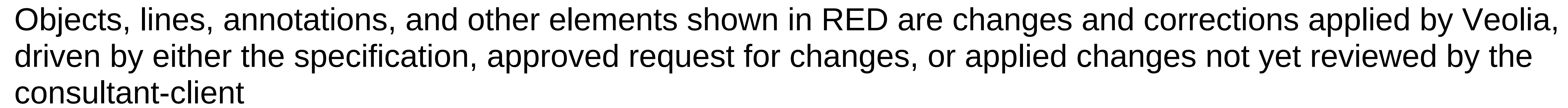
Company Name VEOLIA WATER TECHNOLOGIES
TREATMENT SOLUTIONS USA INC.
Date: January 16, 2026

B1 – P&ID

Project P&ID



Objects that are covered in RED hash-lines are deletions applied by Veolia



D

Veolia Review &
Scope of Supply
December 2nd 2025

GREEN RIVER FILTRATION FACILITY
OZONE SYSTEM REPLACEMENT
CITY OF TACOMA, WA
TACOMA, WA

Jacobs

P&ID

GREEN RIVER FILTRATION FACILITY
OZONE SYSTEM REPLACEMENT
CITY OF TACOMA, WA
TACOMA, WA

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EQUIPMENT PRE-PURCHASE
NOT FOR CONSTRUCTION

POINTS

VERIFY SCALE

BAR IS ONE INCH ON
ORIGINAL DRAWING.

DATE _____

PROJ

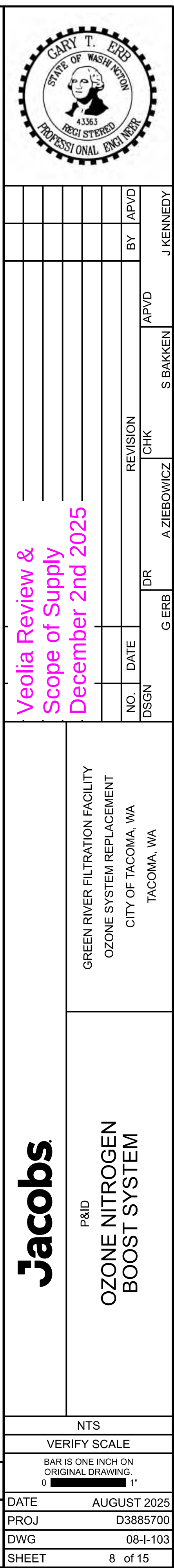
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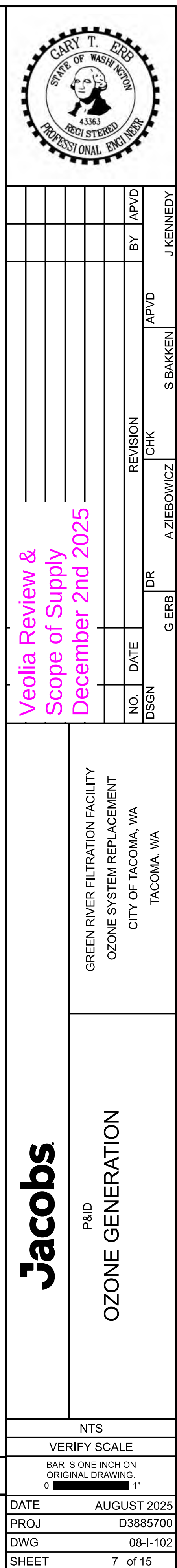
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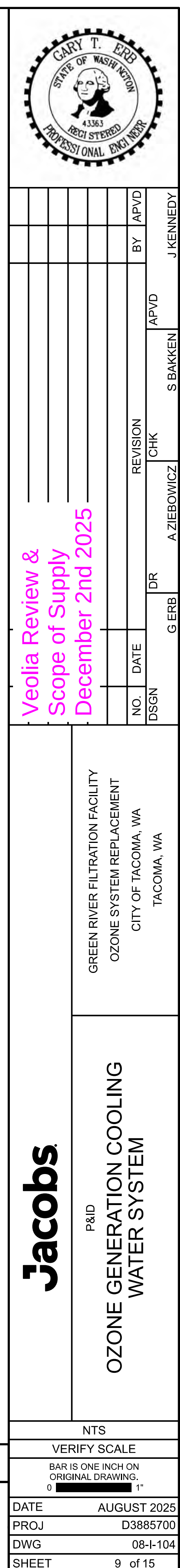
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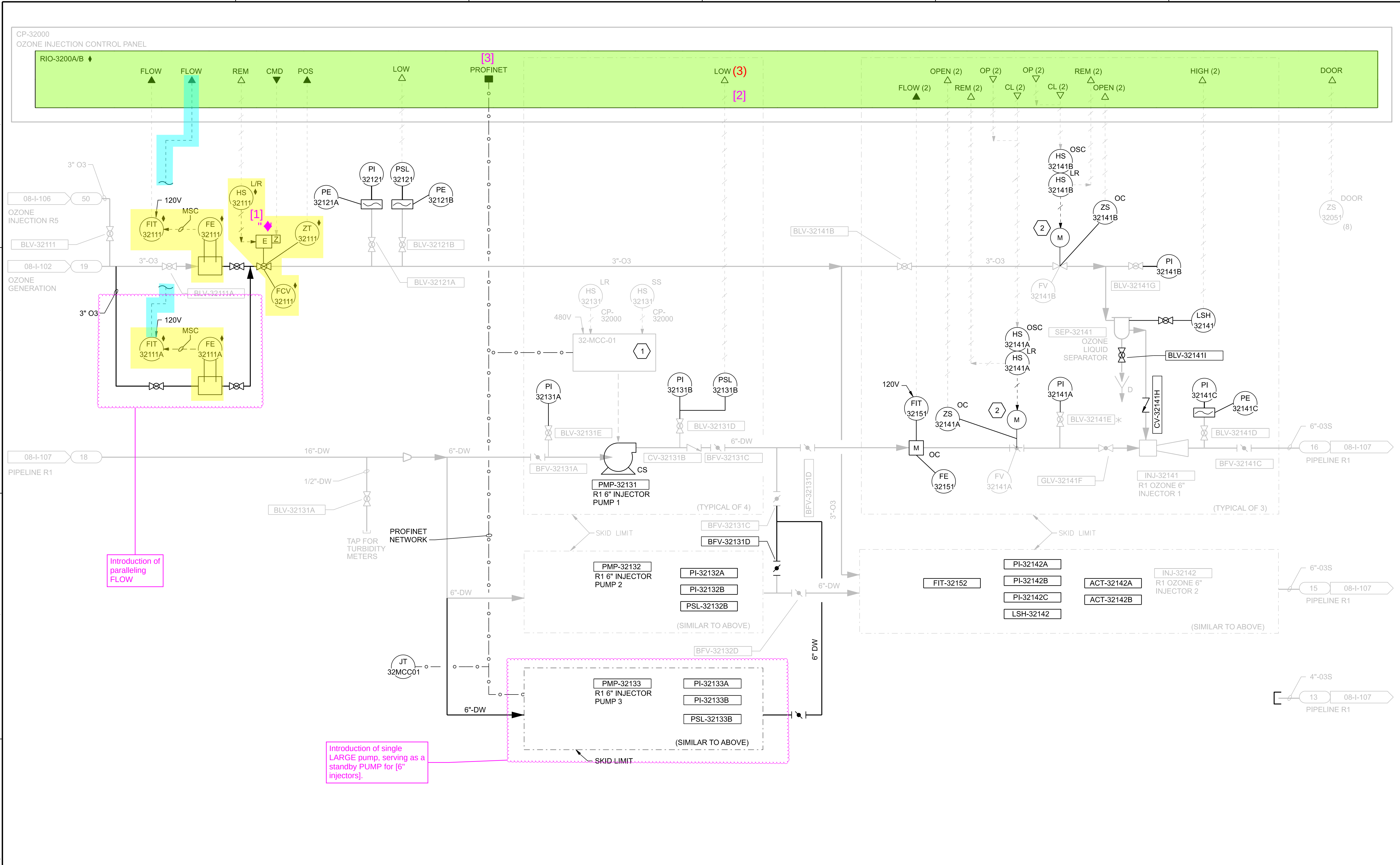
PLOT DATE:

PLOT TIME:









VEOLIA NOTES:

- [1] Valve actuator [FCV-32111] included as per specification
- [2] New signal [PSL-32133B] to RIO-32000A/B
- [3] Refer to 08-I-202 for accurate depiction of PROFINET network architecture and termination

SHEET KEYNOTES

- REFERENCE DRAWING 02-D-601 FOR ELECTRICAL EQUIPMENT UPGRADES.
- REPLACE ACTUATOR FOR EXISTING FLOW VALVE. VALVE TO REMAIN IN PLACE.



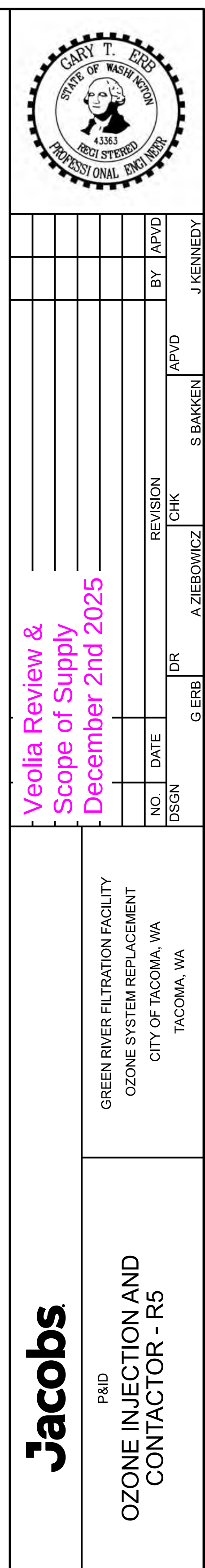
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Veolia Review &
Scope of Supply
December 2nd 2025

GREEN RIVER FILTRATION FACILITY
OZONE SYSTEM REPLACEMENT
CITY OF TACOMA, WA
TACOMA, WA

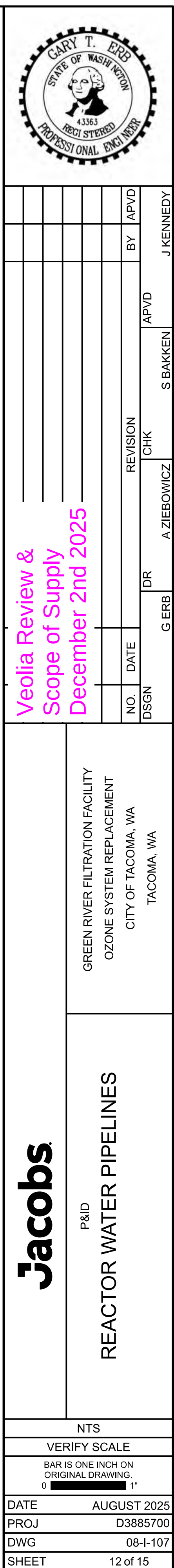
Jacobs
P&ID
OZONE INJECTION AND
CONTACTOR - R1

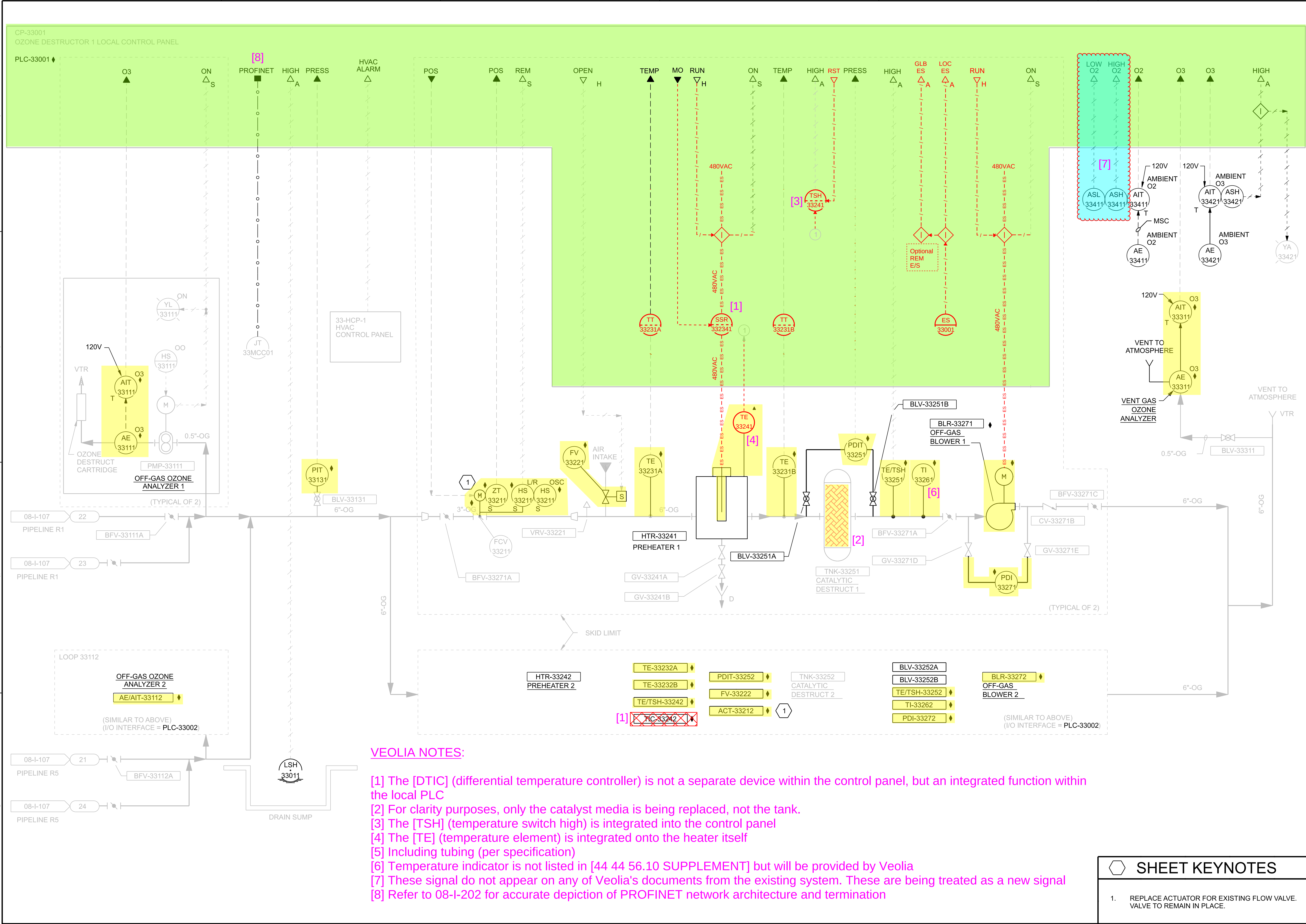
NTS
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
DATE AUGUST 2025
PROJ D3885700
DWG 08-I-105
SHEET 10 of 15



[1] Valve actuator [FCV-32511] included as per specification
[2] Missing signal [ASL-32011] added to P&ID per specification
[3] New signal [PSL-32533B] to RIO-32000A/B
[4] Refer to 08-I-202 for accurate depiction of PROFINET network architecture and termination

NTS	
VERIFY SCALE	
BAR IS ONE INCH ON ORIGINAL DRAWING. 0  1"	
DATE	AUGUST 2025
PROJ	D3885700
DWG	08-I-106
SHEET	11 of 15





VEOLIA NOTES:

- [1] The [DTIC] (differential temperature controller) is not a separate device within the control panel, but an integrated function within the local PLC
- [2] For clarity purposes, only the catalyst media is being replaced, not the tank.
- [3] The [TSH] (temperature switch high) is integrated into the control panel
- [4] The [TE] (temperature element) is integrated onto the heater itself
- [5] Including tubing (per specification)
- [6] Temperature indicator is not listed in [44 44 56.10 SUPPLEMENT] but will be provided by Veolia
- [7] These signal do not appear on any of Veolia's documents from the existing system. These are being treated as a new signal
- [8] Refer to 08-I-202 for accurate depiction of PROFINET network architecture and termination

SHEET KEYNOTES

- 1. REPLACE ACTUATOR FOR EXISTING FLOW VALVE. VALVE TO REMAIN IN PLACE.

Veolia Review &
Scope of Supply
December 2nd 2025

GREEN RIVER FILTRATION FACILITY
OZONE SYSTEM REPLACEMENT
CITY OF TACOMA, WA
TACOMA, WA

JACOBS
P&ID
OZONE OFF-GAS DESTRUCTION

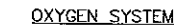
DATE	NOVEMBER 2025
PROJ	D3885700
DWG	08-I-108
SHEET	35 of 77

100% DESIGN SUBMITTAL

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B2 – P&ID

Previous P&ID

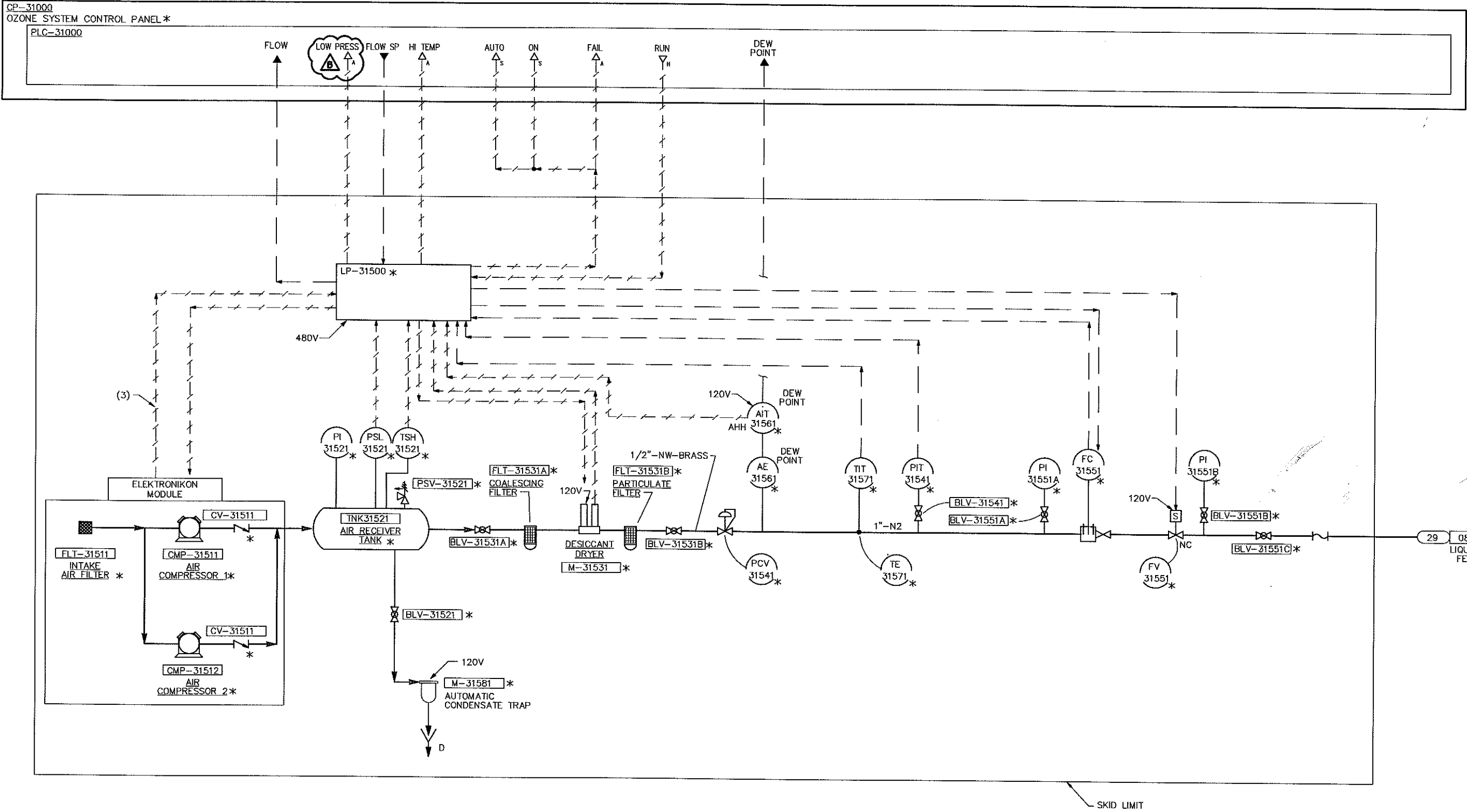


NOTES:

1. * PROVIDED BY OSS.
2. ELECTRICALLY ACTUATED CONTROL VALVES
REQUIRE 480VAC UNLESS INDICATED OTHERWISE.

B	SEE SHEET 3 OF 7	Arg	SC	1/18/2007	SCALE: NONE	TITLE: INSTRUMENTATION AND CONTROLS P&ID LIQUID OXYGEN STORAGE AND FEED GREEN RIVER WTP - TACOMA WATER	 OZONIA® OZONIA NORTH AMERICA Post Office Box 455 Elmwood Park, New Jersey 07407		SHT.: 1 OF 7
A	AS PER ENGINEER'S COMMENTS AND MARKUPS	Arg	SC	8/10/2006	DRAWN: CH2MHILL		SIZE: D	DWG. NO.: 14468-77-0001	REV.: B
-	DERIVED FROM CH2MHILL DRAWING 08-I-01	Arg	SC	4/27/2006	CHECKED: 4.27.06/SC				
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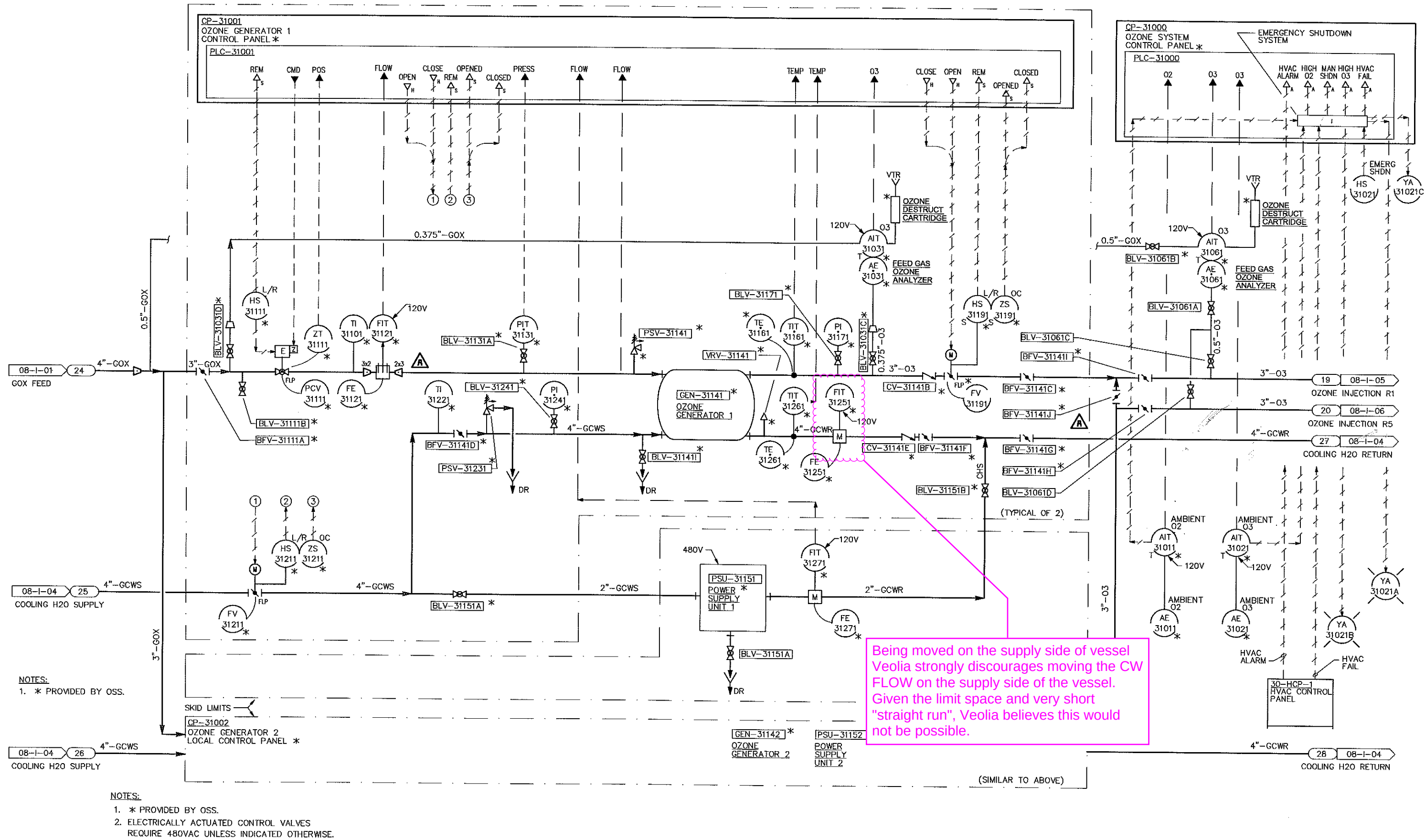
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NOTES:
1. * PROVIDED BY OSS.

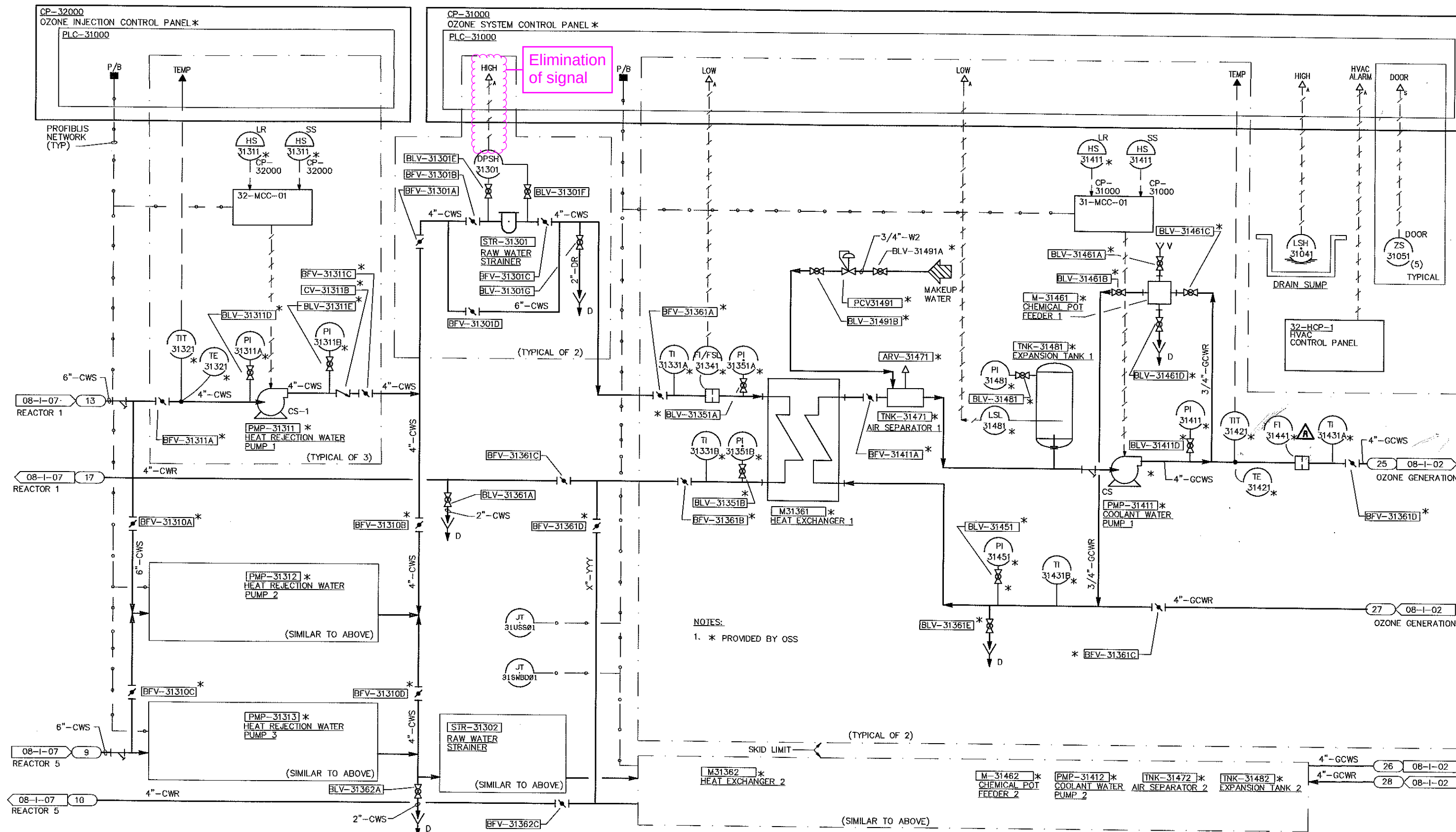
B	PRESSURE ALARM CHANGED	Arg	SC	1/18/2007	SCALE: NONE	TITLE: INSTRUMENTATION AND CONTROLS P&ID OZONE NITROGEN BOOST SYSTEM GREEN RIVER WTP - TACOMA WATER	OZONIA® OZONIA NORTH AMERICA Post Office Box 455 Elmwood Park, New Jersey 07407	SHT.: 3 OF 7
A	AS PER ENGINEER'S COMMENTS AND MARKUPS	Arg	SC	8/10/2006	DRAWN: CH2MHILL			
-	DERIVED FROM CH2MHILL DRAWING 08-I-03	Arg	SC	4/27/2006	CHECKED: 4.27.06/SC			
REV.	DESCRIPTION	DRAWN	APPD.	DATE	APPROVED: 4.27.06/SC			
						SIZE: D	DWG. NO.: 14468-77-0001	REV.: B

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B	SEE SHEET 3 OF 7	Arg	SC	1/18/2007	SCALE: NONE	TITLE: INSTRUMENTATION AND CONTROLS P&ID OZONE GENERATION GREEN RIVER WTP - TACOMA WATER	OZONIA® OZONIA NORTH AMERICA Post Office Box 455 Elmwood Park, New Jersey 07407		SHT.:
A	AS PER ENGINEER'S COMMENTS AND MARKUPS	Arg	SC	8/10/2006	DRAWN: CH2MHILL				2 OF 7
-	DERIVED FROM CH2MHILL DRAWING 08-I-02	Arg	SC	4/27/2006	CHECKED: 4.27.06/SC				
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B	SEE SHEET 3 OF 7	Arg	SC	1/18/2007	SCALE: NONE	TITLE: INSTRUMENTATION AND CONTROLS P&ID CH2MHILL OZONE GENERATION COOLING WATER SYSTEM GREEN RIVER WTP - TACOMA WATER	OZONIA® OZONIA NORTH AMERICA Post Office Box 455 Elmwood Park, New Jersey 07407	SHT.:
A	AS PER ENGINEER'S COMMENTS AND MARKUPS	Arg	SC	8/10/2006	DRAWN: CH2MHILL			4 OF 7
-	DERIVED FROM CH2MHILL DRAWING 08-I-04	Arg	SC	4/27/2006	CHECKED: 4.27.06/SC			
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						SIZE: D	DWG. NO.: 14468-77-0001	REV.: B



B	SEE SHEET 3 OF 7	Arg	SC	1/18/2007	SCALE: NONE	INSTRUMENTATION AND CONTROLS P&ID OZONE INJECTION AND CONTACTOR - R1 GREEN RIVER WTP - TACOMA WATER	 OZONIA NORTH AMERICA Post Office Box 455 Elmwood Park, New Jersey 07407	SHT.:
A	AS PER ENGINEER'S COMMENTS AND MARKUPS	Arg	SC	8/10/2006	DRAWN: CH2MHILL			5 OF 7
-	DERIVED FROM CH2MHILL DRAWING 08-I-05	Arg	SC	4/27/2006	CHECKED: 4.27.06/SC			REV.:
REV.	DESCRIPTION	DRAWN	APPD.	DATE	APPROVED: 4.27.06/SC			B



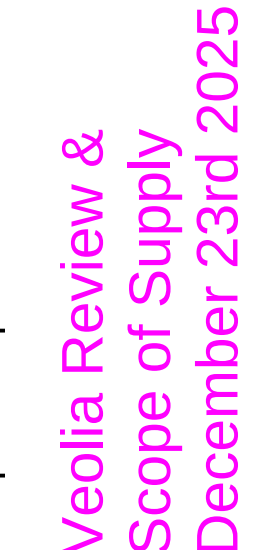
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A	AS PER ENGINEER'S COMMENTS AND MARKUPS	Arg	SC	8/10/2006	DRAWN: CH2MHILL		SIZE: D DWG. NO.: 14468-77-0001	REV.: B	
-	DERIVED FROM CH2MHILL DRAWING 08-1-06	Arg	SC	4/27/2006	CHECKED: 4.27.06/SC				
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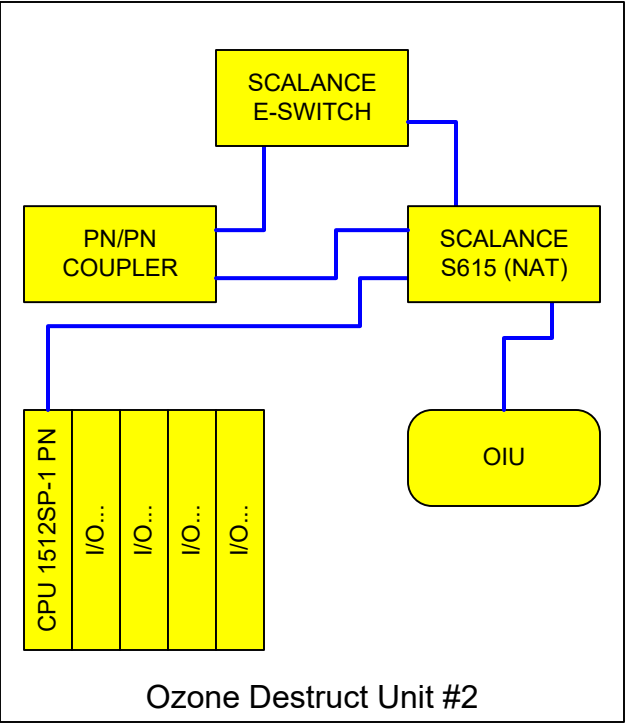
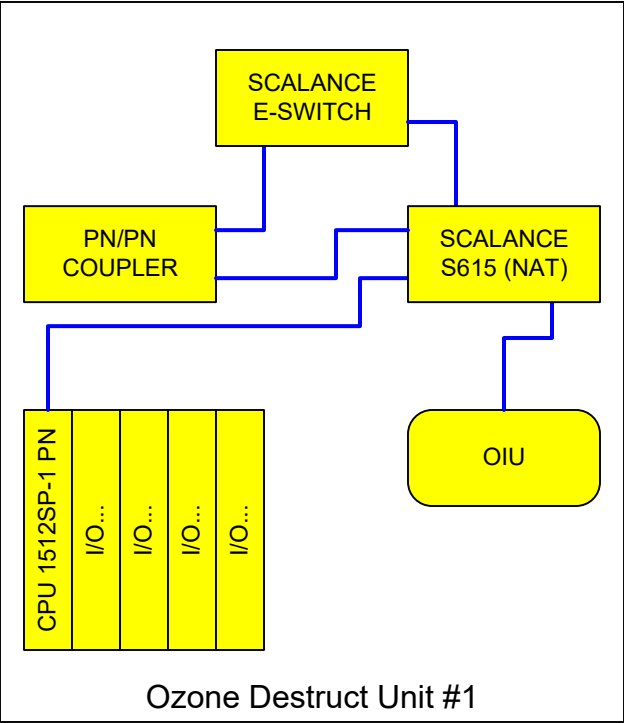
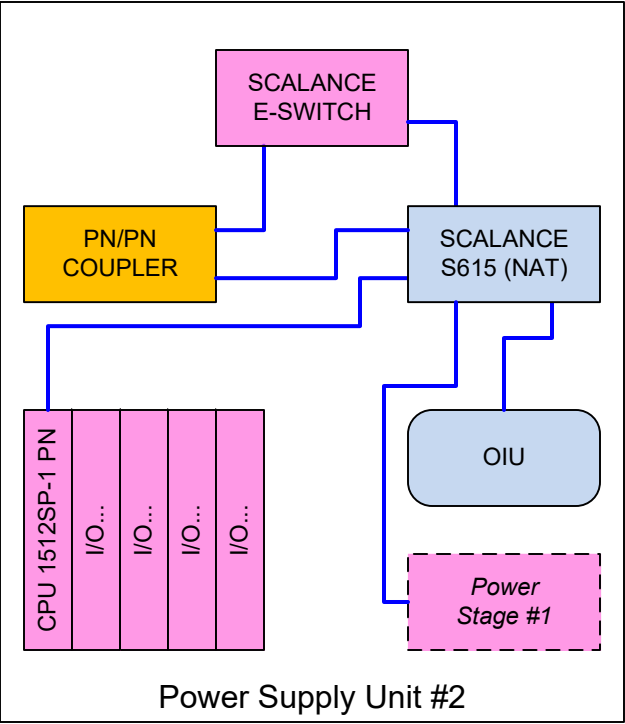
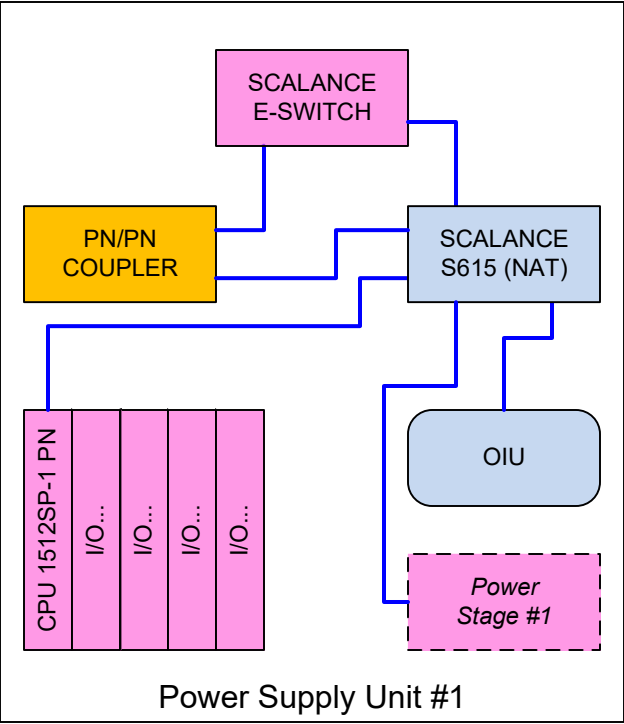


1. * PROVIDED BY OSS

B	SEE SHEET 3 OF 7	Arg	SC	1/18/2007	SCALE: NONE	TITLE: INSTRUMENTATION AND CONTROLS P&ID OZONE OFF-GAS DESTRUCTION GREEN RIVER WTP - TACOMA WATER	OZONIA® OZONIA NORTH AMERICA Post Office Box 455 Elmwood Park, New Jersey 07407		SHT.: 7 OF 7
A	AS PER ENGINEER'S COMMENTS AND MARKUPS	Arg	SC	8/10/2006	DRAWN: CH2MHILL		SIZE: D DWG. NO.: 14468-77-0001	REV.: B	
-	DERIVED FROM CH2MHILL DRAWING 08-1-08	Arg	SC	4/27/2006	CHECKED: 4.27.06/SC				
REV.	DESCRIPTION	DRAWN	APPD.	DATE	APPROVED: 4.27.06/SC				

C – Network Diagram





NOTES

1. Preliminary, not for construction
2. Component(s) shown in YELLOW are provided as part of the this project
3. Components shown in MAGENTA were provided as part of the original “PSU Replacement” project
3. Component(s) shown in ORANGE are provided as part of this project, being added to the deliverables of the original “PSU Replacement” project
4. Component(s) shown in BLUE are provided as part of this project, modifying the deliverables of the original “PSU Replacement” project

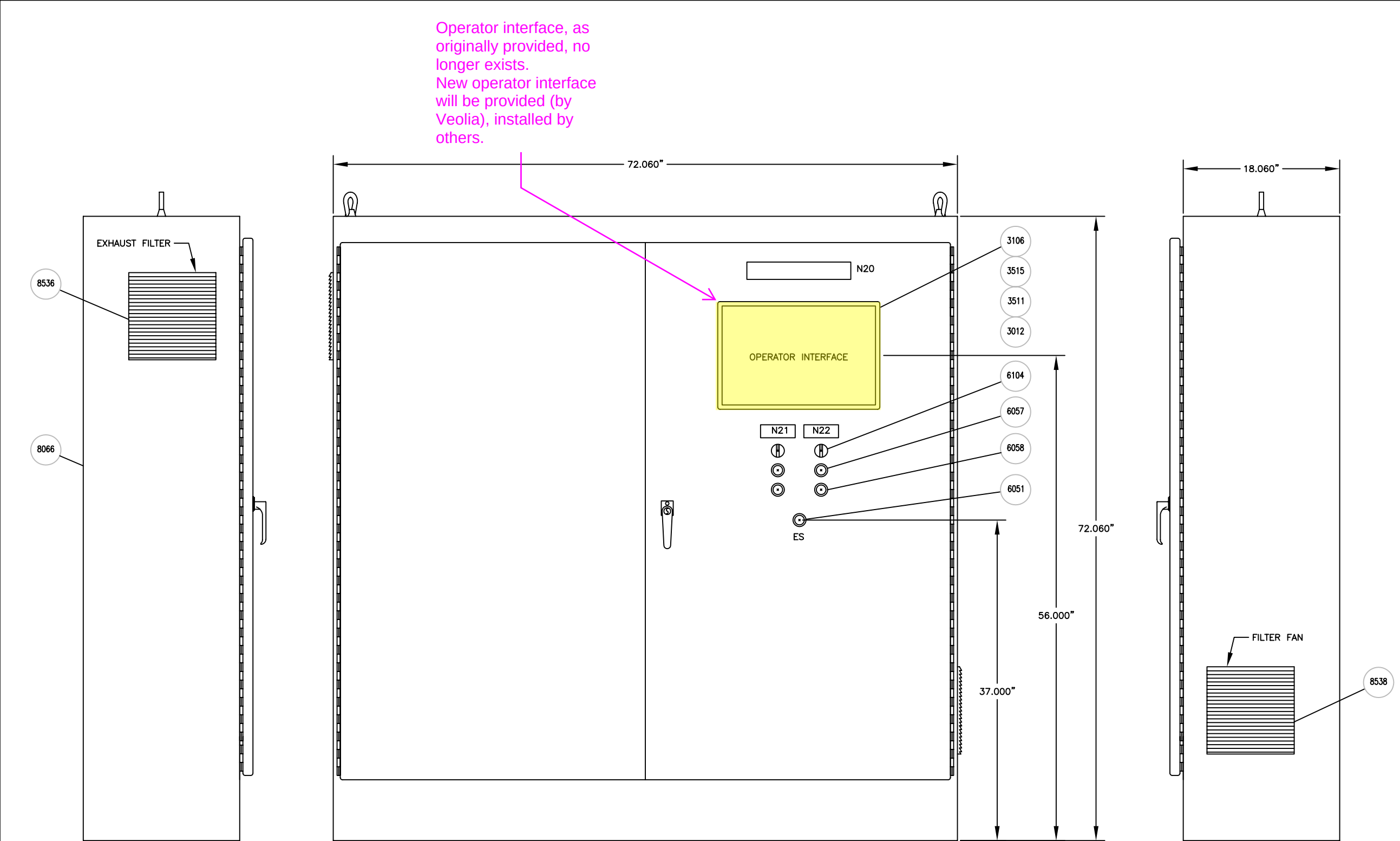
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D – Bill of Materials

P&ID	SUB-SYSTEM	SUB-SUB-SYSTEM	LOOSE	ON SKID (Tag or Name)	QTY	TAG	DESCRIPTION	SPECIFICATION	MANUFACTURER	SERIES or MODEL
08-I-101	Oxygen Gas Header		X		1	AIT-35531	Dewpoint Analyzer	44 44 56.10	Michell Easidew	TBD
08-I-103	Supplemental Nitrogen Gas Header		X		1	AIT-31561	Dewpoint Analyzer	44 44 56.10	Michell Easidew	TBD
08-I-103	Supplemental Nitrogen Gas Header		X		1	FCV/FIT-31551	Flow Indicating/Controller	44 44 56 44 44 56.10	Brooks	MF Series
08-I-102	Ozone Generation System	OZONE GENERATOR X	X		2	PCV-31111 PCV-31112	Pressure Control Valve + Actuator	44 44 56.10	Valve: Emerson Actuator: ROTORK	Valve: Fischer V200 (3 ") Actuator: ROTORK IQT
08-I-102	Ozone Generation System	OZONE GENERATOR X	X		2	FIT-31121 FIT-31122	Thermal Mass Flow Transmitter	44 44 56.10	E&H	TBD
08-I-102	Ozone Generation System	OZONE GENERATOR X	X		2	AIT-31031 AIT-31032	High Concentration Ozone Analyzer	44 44 56.10	BMT	BMT 964
08-I-102	Ozone Generation System	OZONE HEADER	X		1	AIT-31061	High Concentration Ozone Analyzer	44 44 56.10	BMT	BMT 964
08-I-105	Ozone Delivery System	GAS LINE INJECTION SYSTEM REACTOR 1	X		1	FCV-32111	Gas Flow Control Valve + Actuator	44 44 56.10	Valve: Emerson Actuator: ROTORK	Valve: Fischer V200 (1.5 ") Actuator: ROTORK IQT
08-I-105	Ozone Delivery System	GAS LINE INJECTION SYSTEM REACTOR 1	X		1	FIT-32111	Thermal Mass Flow Transmitter	44 44 56.10	E&H	TBD
08-I-105	Ozone Delivery System	GAS LINE INJECTION SYSTEM REACTOR 1	X		1	FIT-32111A	Thermal Mass Flow Transmitter	44 44 56.10	E&H	TBD
08-I-106	Ozone Delivery System	GAS LINE INJECTION SYSTEM REACTOR 5	X		1	FCV-32511	Gas Flow Control Valve + Actuator	44 44 56.10	Valve: Emerson Actuator: ROTORK	Valve: Fischer V200 (1.5 ") Actuator: ROTORK IQT
08-I-106	Ozone Delivery System	GAS LINE INJECTION SYSTEM REACTOR 5	X		1	FIT-32511	Thermal Mass Flow Transmitter	44 44 56.10	E&H	TBD
08-I-106	Ozone Delivery System	GAS LINE INJECTION SYSTEM REACTOR 5	X		1	FIT-32511A	Thermal Mass Flow Transmitter	44 44 56.10	E&H	TBD
08-I-108	Ozone Contacting and Off-Gassing System	OFF-GAS LINE REACTOR PIPELINE x	X		2	AIT-33111 AIT-33112	Medium Concentation Ozone Analyzer	44 44 56.10	Teledyne	465M
08-I-108	Ozone Contacting and Off-Gassing System	OFF-GAS HEADER	X		1	PIT-33131	Pressure Indicating Transmitter	44 44 56.10	E&H	TBD
08-I-108	Ozone Destruct System	DESTRUCT X	X		2	ACT-33211 ACT-33212	Gas Isolation Valve Actuator (actuator only)		Valve: N/A Actuator: ROTORK	Valve: N/A Actuator: ROTORK IQT
08-I-108	Ozone Destruct System	DESTRUCT X	X		2	FV-33221 FV-33222	Solenoid Valve		ASCO	TBD
08-I-108	Ozone Destruct System	DESTRUCT X	X		4	TE-33231A,B TE-33232A,B	Temperature Element	44 44 56.10	Ashcroft	TBD
08-I-108	Ozone Destruct System	DESTRUCT X	X		2	HTR-33241 HTR-33242	Preheater w/ integrated TE-3324x		Heatrex	Circulation Heater 2.9kW (4" connection)
08-I-108	Ozone Destruct System	DESTRUCT X	X		2	PDIT-33251 PDIT-33252	Differential Pressure Indicating Transmitter	44 44 56.10	E&H	TBD
08-I-108	Ozone Destruct System	DESTRUCT X	X		2	TSH-33251 TSH-33252	Temperature Switch	44 44 56.10	Ashcroft	TBD
08-I-108	Ozone Destruct System	DESTRUCT X	X		2	TI-33261 TI-33262	Temperature Indicator	44 44 56.10	Ashcroft	TBD
08-I-108	Ozone Destruct System	DESTRUCT X	X		2	BLR-33271 BLR-33272	Off-Gas Blower		Cincinnati Fan	Cincinnati Fan, HPD, 17" wheel size
08-I-108	Ozone Destruct System	DESTRUCT X	X		2	PDI-33271 PDI-33272	Differential Pressure Indicator	44 44 56.10	Midwest	TBD
08-I-108	Ozone Destruct System	VENT-GAS HEADER	X		1	AIT-33311	Vent Gas Ozone Analyzer	44 44 56.10	Teledyne	465L

E1 – Control Panels

MOCP



NOTES

ALL DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED

1. FOR ITEM NUMBERS, SEE DRAWING 0694-TS-011 PAGE 5 AND 6

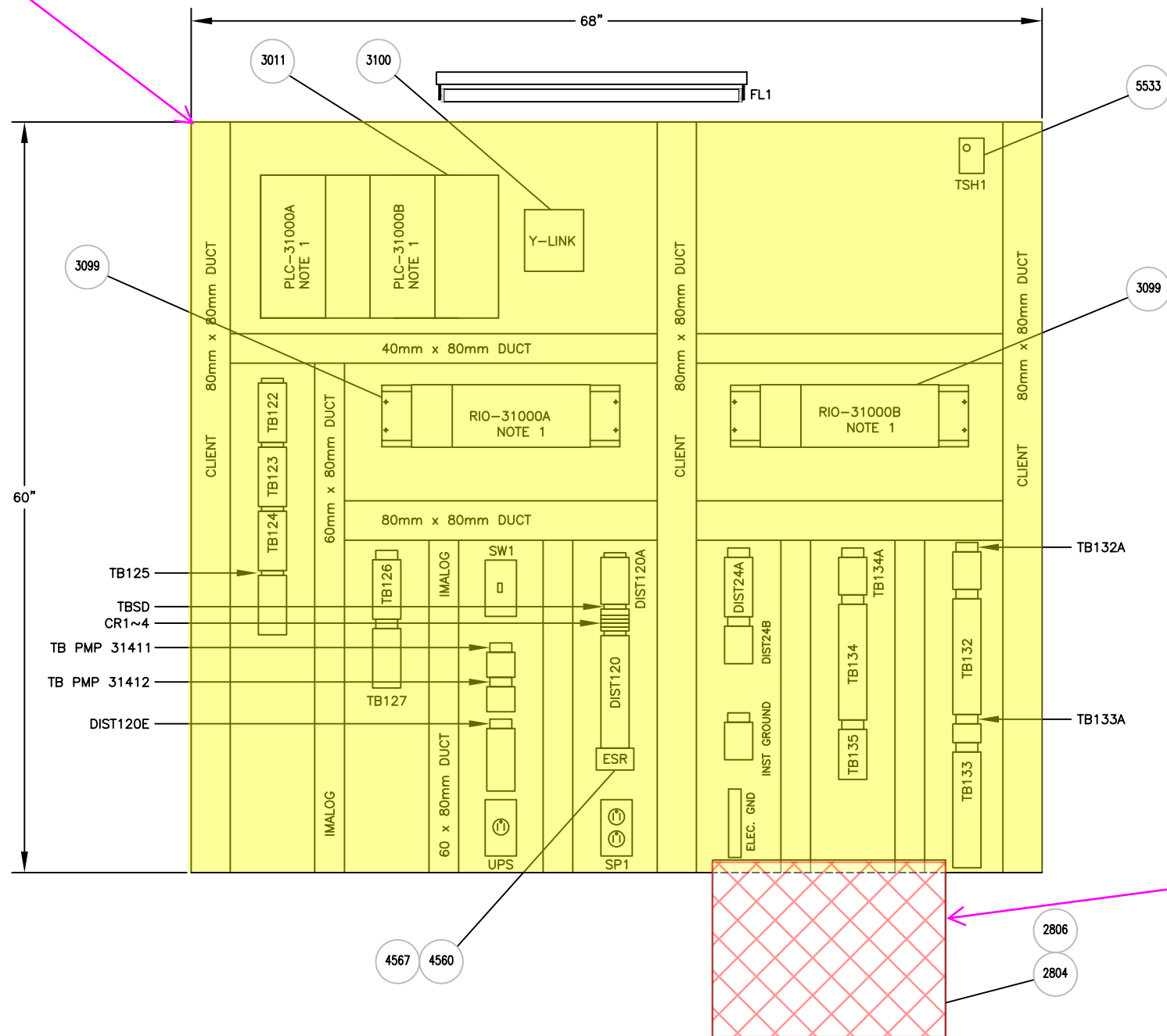
FINAL ISSUE
2007-07-17

4	06-10-26	MH	VT
3	06-10-17	YW	VT
2	06-10-11	YW	VT
1	06-08-25	MH	VT
REV	DATE	DRAWN	CHECKED

NOTES

1. FOR PLC DETAILS, SEE PAGE 5 & 6
2. FOR ITEM NUMBERS, SEE DRAWING
0694-TS-011 PAGE 5 AND 6

Back-panel and mounted components will be completely replaced.



- No longer applicable "...panel to receive UPS power from an external facility UPS system provided by others."

FINAL ISSUE
2007-07-17

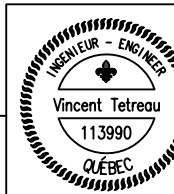
3	07-01-08	YW	VT
2	06-12-15	CS	VT
1	06-09-11	YW	VT
0	06-05-10	YW	VT
REV	DATE	DRAWN	CHECKED

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TACOMA GREEN RIVER WTP
OZONATION FACILITY

CP-31000

O3ONIA



PLOT COLORS IN BLACK EXCEPT 253
P04_R08/AUTOCAD 16.0
SCALE: 1in.=1ft. PLOT: 1=12
IMALOG PROJECT No: M-0694



MASTER OZONE CONTROL PANEL
LAYOUT DRAWING
INTERNAL DETAIL

DWG No:
0694-TE-011

PAGE	REV
2	3

NOTES

1. FOR PLC DETAILS, SEE PAGE 5 & 6
2. FOR ITEM NUMBERS, SEE DRAWING 0694-TS-011 PAGE 5 AND 6

FINAL ISSUE
2007-07-17

3	07-01-08	YW	VT
2	06-12-15	CS	VT
1	06-09-11	YW	VT
0	06-05-10	YW	VT
REV	DATE	DRAWN	CHECKED

MASTER OZONE CONTROL PANEL
LAYOUT DRAWING
INTERNAL DETAIL

DWG No:	PAGE	REV
0694-TE-011	2	3

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TACOMA GREEN RIVER WTP
OZONATION FACILITY

CP-31000

OZONIA



PLOT COLORS IN BLACK EXCEPT 253
P04_R08/AUTOCAD 16.0
SCALE: 1in.=1ft. PLOT: 1=12
IMALOG PROJECT No: M-0694



Non-highlighted
mounted components
will either be eliminated
or replaced, depending
on their use and needs.

Placement will
remain as per the
existing

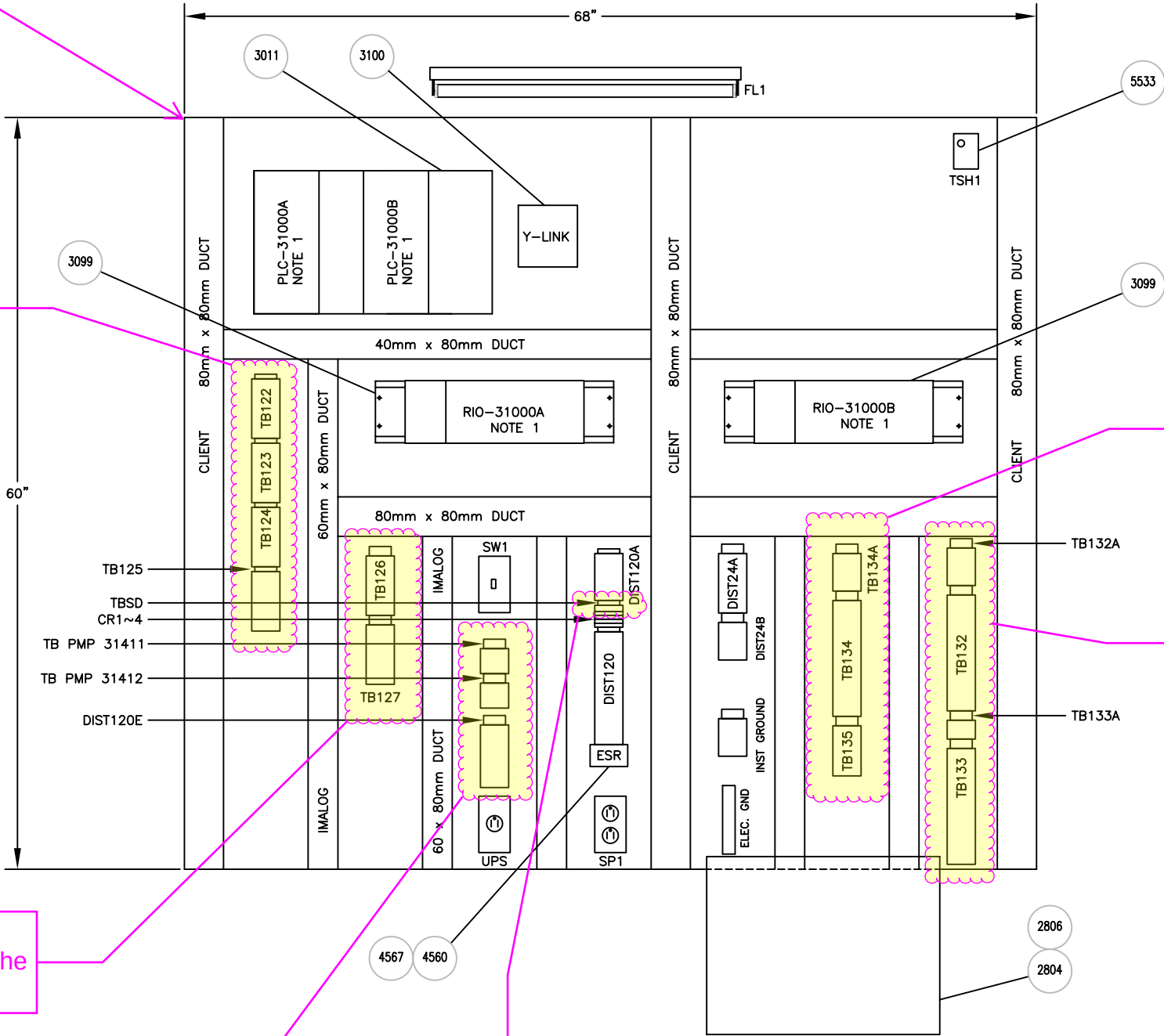
Placement will
remain as per the
existing

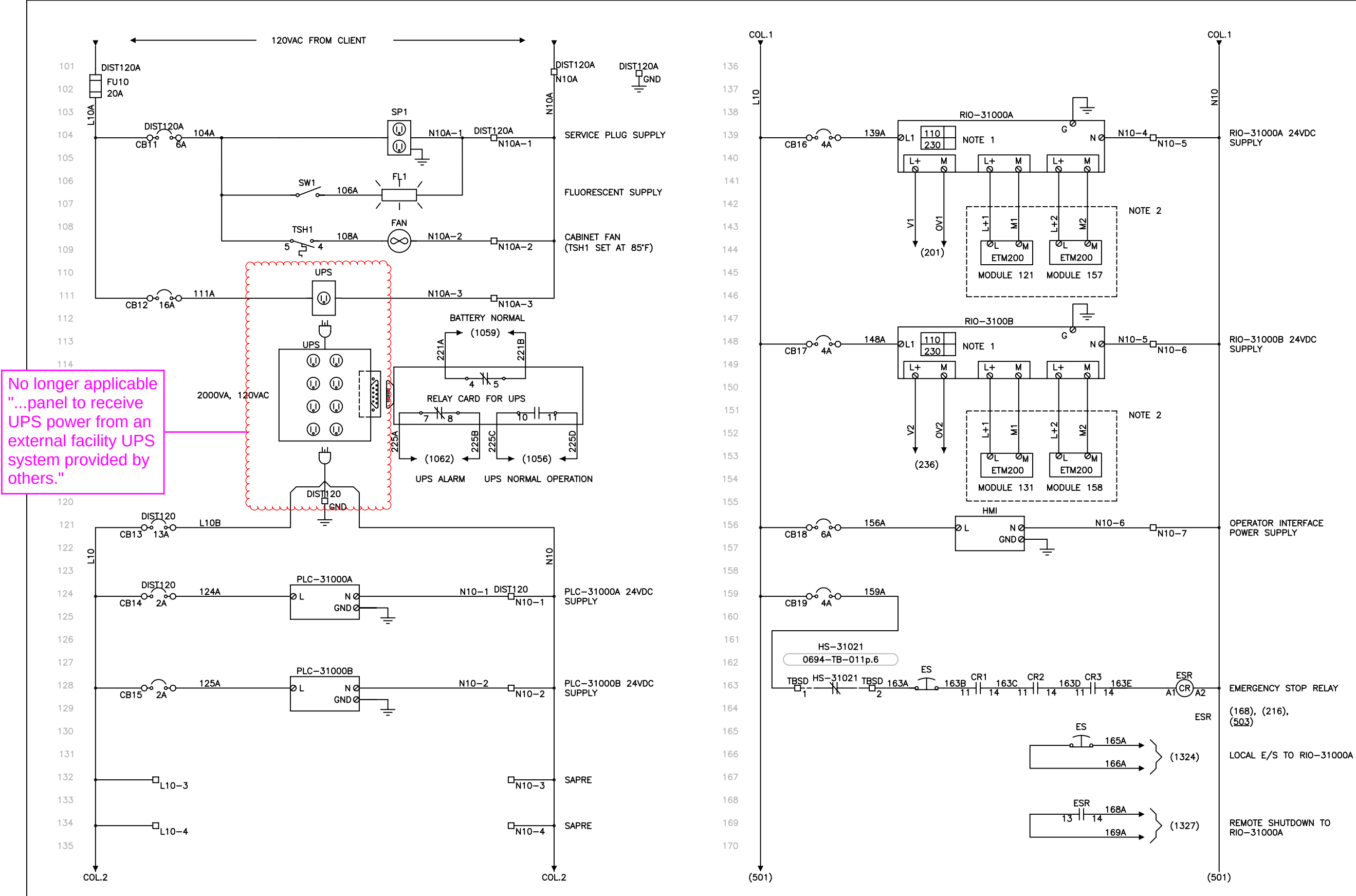
Placement will
remain as per the
existing

Placement will
remain as per the
existing

Placement will
remain as per the
existing

Placement will
remain as per the
existing





NOTES

1. SET P/S INPUT VOLTAGE TO 120V
2. SEE DRAWING 0694-TG-011 P.1

FINAL ISSUE
2007-07-17

5	07-04-16	MH	VT
4	06-12-18	CS	VT
3	06-11-24	YW	VT
2	06-10-18	MH	VT
REV	DATE	DRAWN	CHECKED

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TACOMA GREEN RIVER WTP
OZONATION FACILITY

CP-31000

OZONIA



PLOT COLORS IN BLACK EXCEPT 253
P04_R08/AUTOCAD 16.0
SCALE: NTS PLOT: 1= 2.15
IMALOG PROJECT No: M-0694



MASTER OZONE CONTROL PANEL
ELECTRICAL SCHEMATIC DRAWING
CONTROL POWER DISTRIBUTION
120VAC SUPPLY

DWG No: 0694-TD-011
PAGE 1
REV 5

E2 – Control Panels

OICP

NAMEPLATES MATERIAL CODE:

X-COLOR1/COLOR2

COLOR2 = BACKGROUND COLOR

COLOR 1 = LETTERING COLOR

M = SELF-ADHESIVE ALUMINUM METAL-PHOTO

L = SELF-ADHESIVE ENGRAVED LAMICOID

OZONE INJECTION CONTROL PANEL
CP-32000

N40

HEAT REJECTION WATER PUMP
PMP-31311
HAND OFF REMOTE

N41

HEAT REJECTION WATER PUMP
PMP-31313
HAND OFF REMOTE

N47

HEAT REJECTION WATER PUMP
PMP-31312
HAND OFF REMOTE

N42

INJECTOR WATER PUMP
PMP-32131
HAND OFF REMOTE

N43

INJECTOR WATER PUMP
PMP-32133
HAND OFF REMOTE

N49

Changed/
Replaced

INJECTOR WATER PUMP
PMP-32132
HAND OFF REMOTE

N44

INJECTOR WATER PUMP
PMP-32134
HAND OFF REMOTE

N50

Removed/
Eliminated

INJECTOR WATER PUMP
PMP-32531
HAND OFF REMOTE

N45

INJECTOR WATER PUMP
PMP-32533
HAND OFF REMOTE

N51

Changed/
Replaced

INJECTOR WATER PUMP
PMP-32532
HAND OFF REMOTE

N46

INJECTOR WATER PUMP
PMP-32534
HAND OFF REMOTE

N52

Removed/
Eliminated

NAMEPLATES REARRANGED

NOTES

FINAL ISSUE
2007-07-19

2	06-11-27	YW	VT
1	06-09-28	YW	VT
0	06-05-11	YW	VT
REV	DATE	DRAWN	CHECKED

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TACOMA GREEN RIVER WTP
OZONATION FACILITY

CP-32000

OZONIA

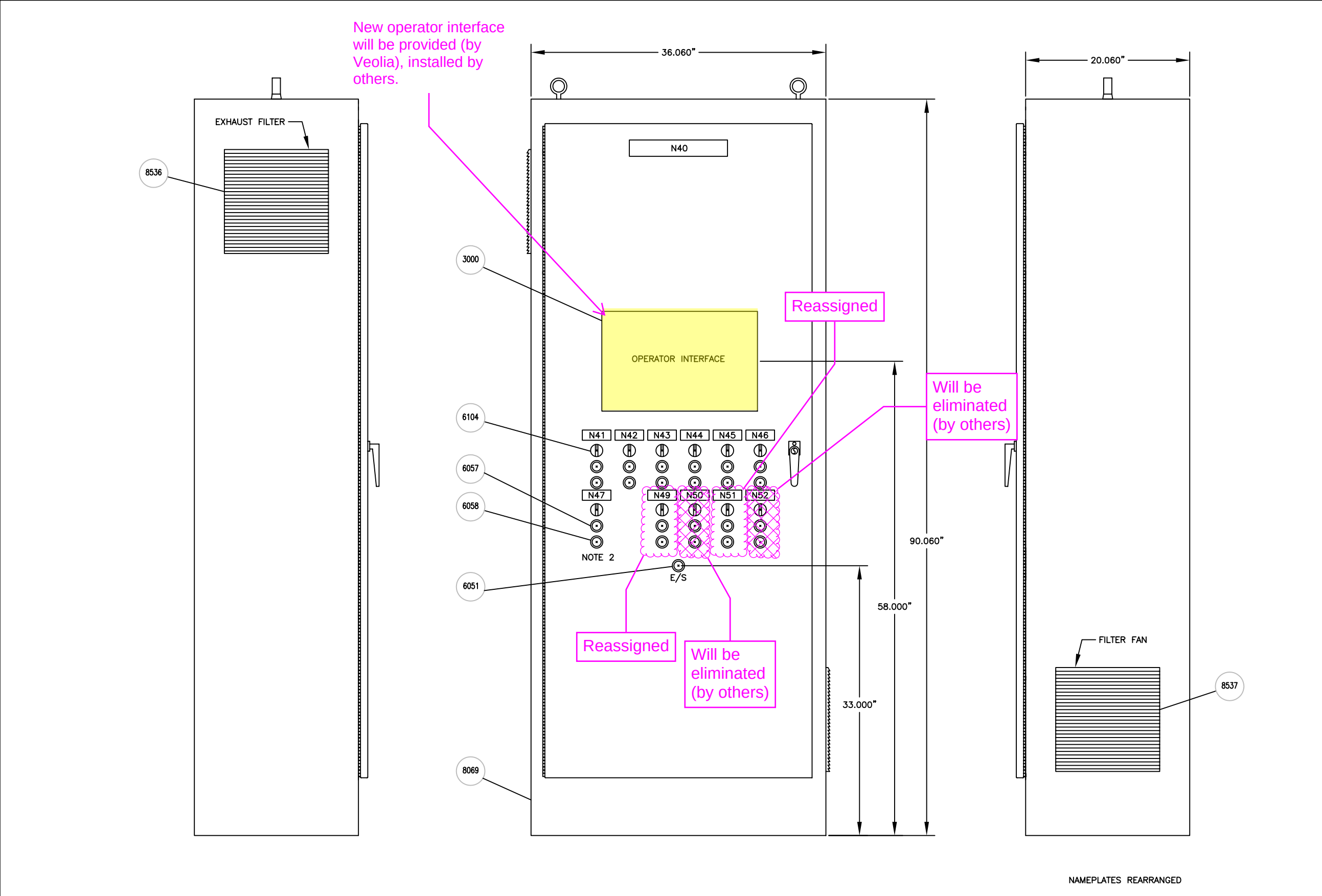


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P04_R08/AUTOCAD 16.0
SCALE: NTS PLOT: 1= 2.15
IMALOG PROJECT No: M-0694



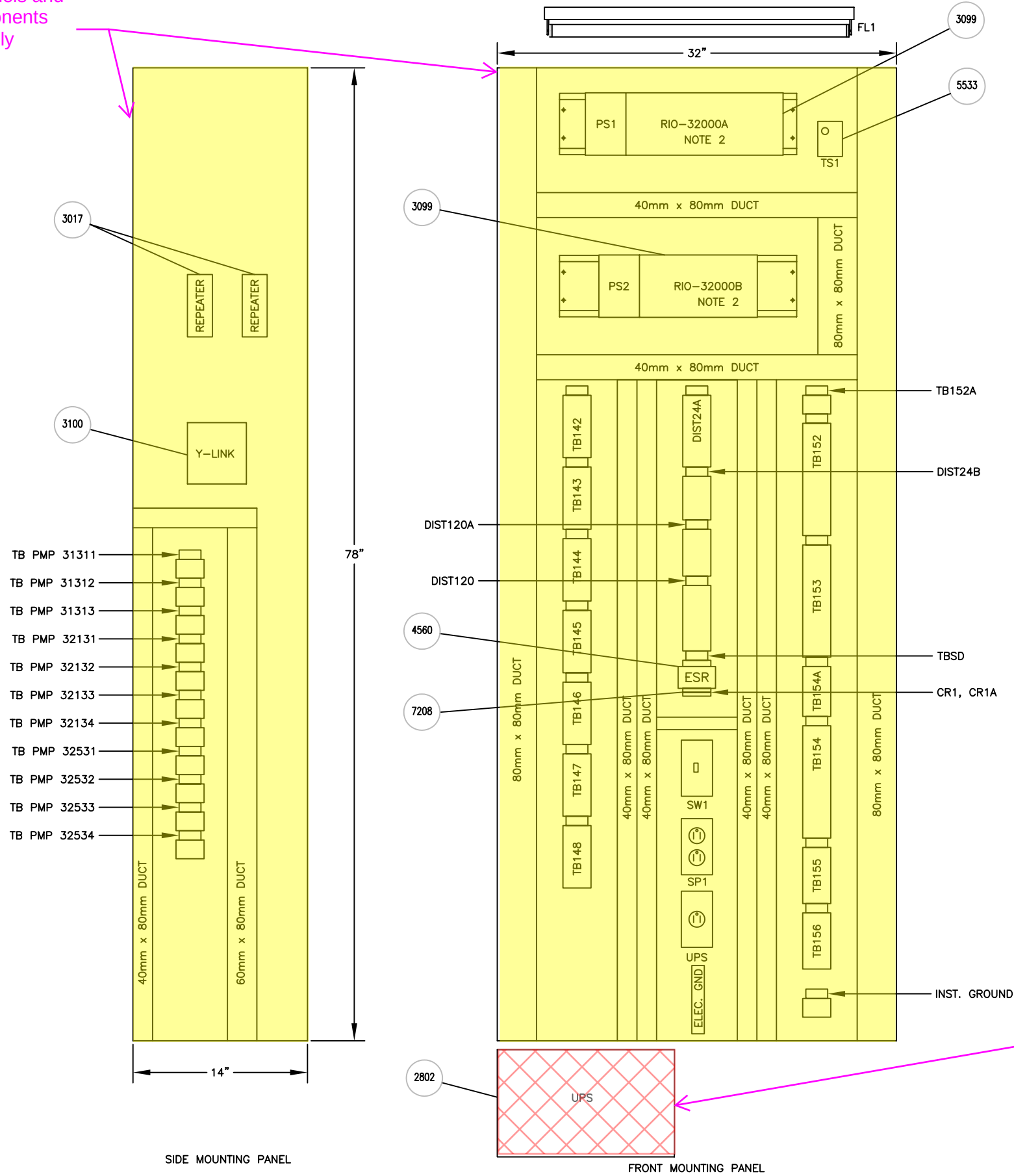
OZONE INJECTION CONTROL PANEL
STANDARDS AND SPECIFICATIONS
LIST OF NAMEPLATES

DWG No:	PAGE	REV
0694-TS-013	4	2



NOTES			
ALL DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED			
1. FOR ITEM NUMBERS, SEE DRAWING 0694-TS-013 PAGE 5 AND 6			
2. FOR PUSH BUTTONS & SELECTORS INFORMATION, SEE DRAWING 0694-TE-013 PAGE 3			
FINAL ISSUE 2007-07-19			
5	07-01-11	YW	VT
4	06-11-27	YW	VT
3	06-10-12	YW	VT
2	06-09-28	YW	VT
REV	DATE	DRAWN	CHECKED

Back & side panels and mounted components will be completely replaced.



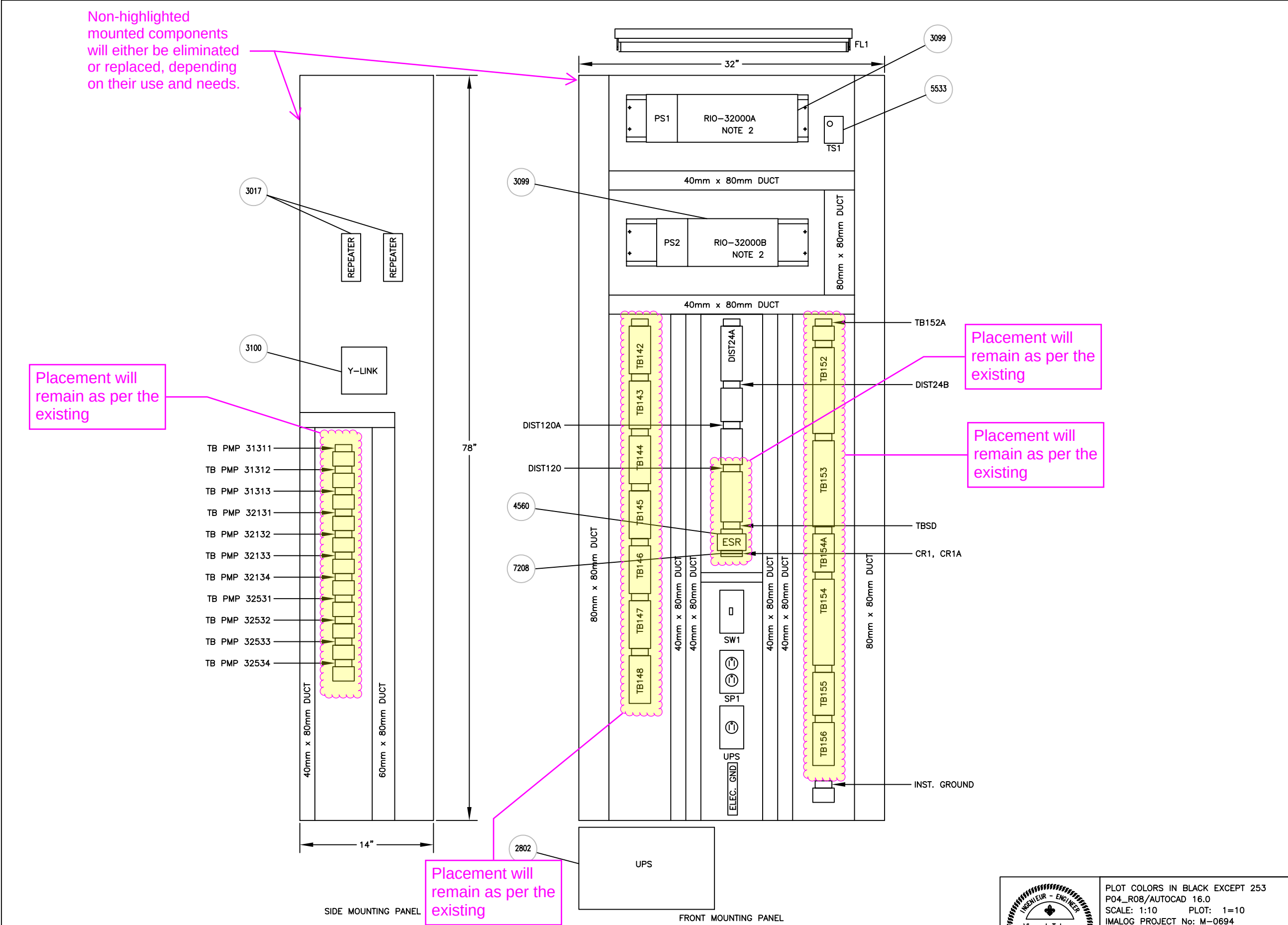
NOTES

1. FOR ITEM NUMBERS, SEE DRAWING 0694-TS-013 PAGE 5 AND 6
2. FOR PLC'S DETAIL, SEE PAGE 5

FINAL ISSUE
2007-07-19

3	06-12-14	YW	VT
2	06-10-06	YW	VT
1	06-09-11	YW	VT
0	06-05-11	YW	VT
REV	DATE	DRAWN	CHECKED

No longer applicable
"...panel to receive UPS
power from an external
facility UPS system
provided by others."



NOTES

1. FOR ITEM NUMBERS, SEE DRAWING 0694-TS-013 PAGE 5 AND 6

2. FOR PLC'S DETAIL, SEE PAGE 5

FINAL ISSUE

2007-07-19

3	06-12-14	YW	VT
2	06-10-06	YW	VT
1	06-09-11	YW	VT
0	06-05-11	YW	VT
REV	DATE	DRAWN	CHECKED

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TACOMA GREEN RIVER WTP
OZONATION FACILITY

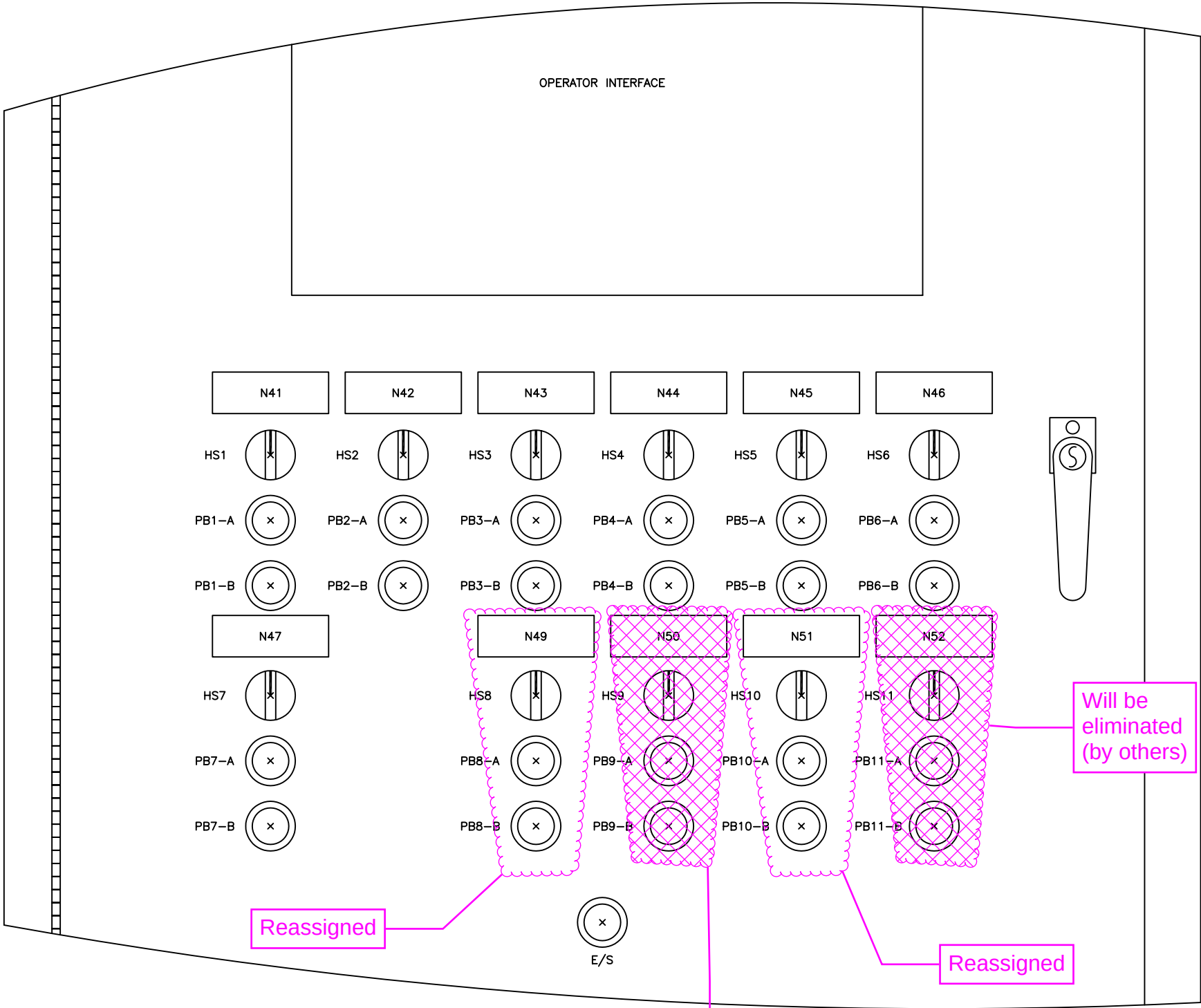
CP-32000

PLOT COLORS IN BLACK EXCEPT 253
P04_R08/AUTOCAD 16.0
SCALE: 1:10 PLOT: 1=10
IMALOG PROJECT No: M-0694

DWG No:
0694-TE-013

PAGE
2

REV
3



NOTES

FINAL ISSUE
2007-07-19

0	07-01-11	YW	VT
REV	DATE	DRAWN	CHECKED

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TACOMA GREEN RIVER WTP
OZONATION FACILITY

CP-32000

OZONIA

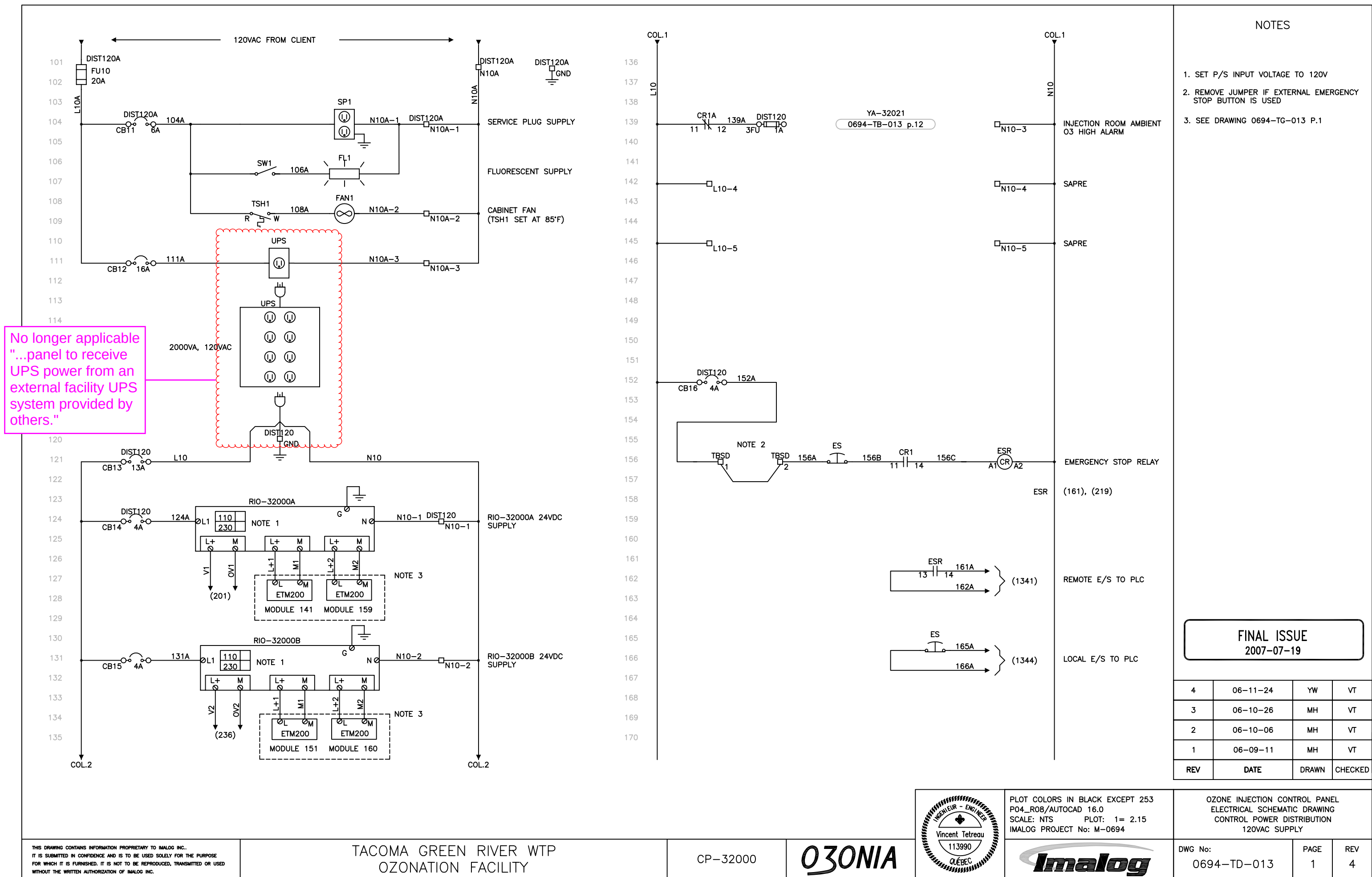


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P04_R08/AUTOCAD 16.0
SCALE: 1in.=1ft. PLOT: 1=12
IMALOG PROJECT No: M-0694



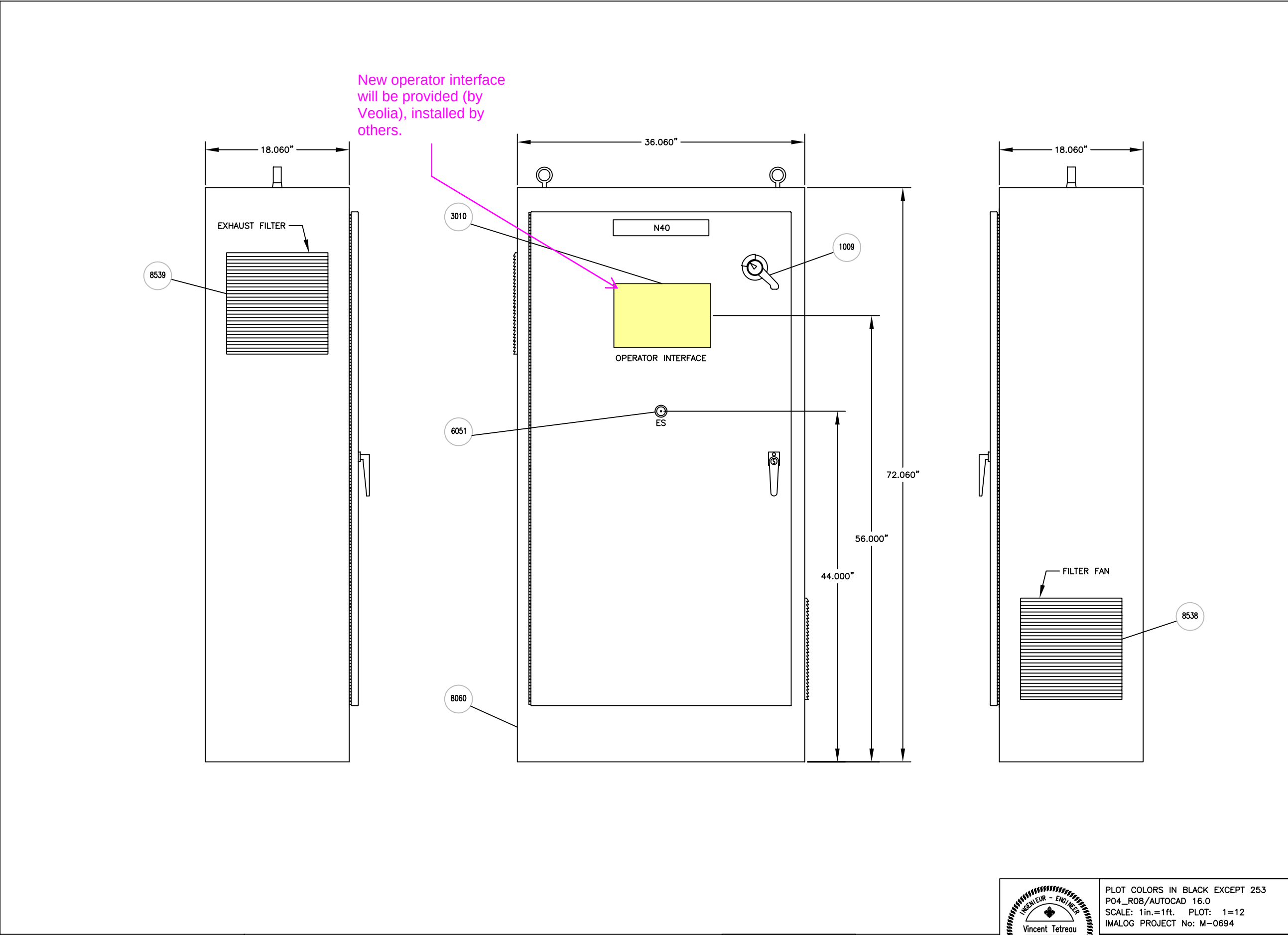
OZONE INJECTION CONTROL PANEL
LAYOUT DRAWING
DETAILS FOR SELECTORS AND
PUSH BUTTONS

DWG No: 0694-TE-013	PAGE 3	REV 0



E3 – Control Panels

ODCP



NOTES

FINAL ISSUE
2007-07-19

3	07-07-17	CS	VT
2	07-01-11	YW	VT
1	06-09-11	YW	VT
0	06-05-11	YW	VT
REV	DATE	DRAWN	CHECKED

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TACOMA GREEN RIVER WTP
OZONATION FACILITY

CP-33001

O3ONIA



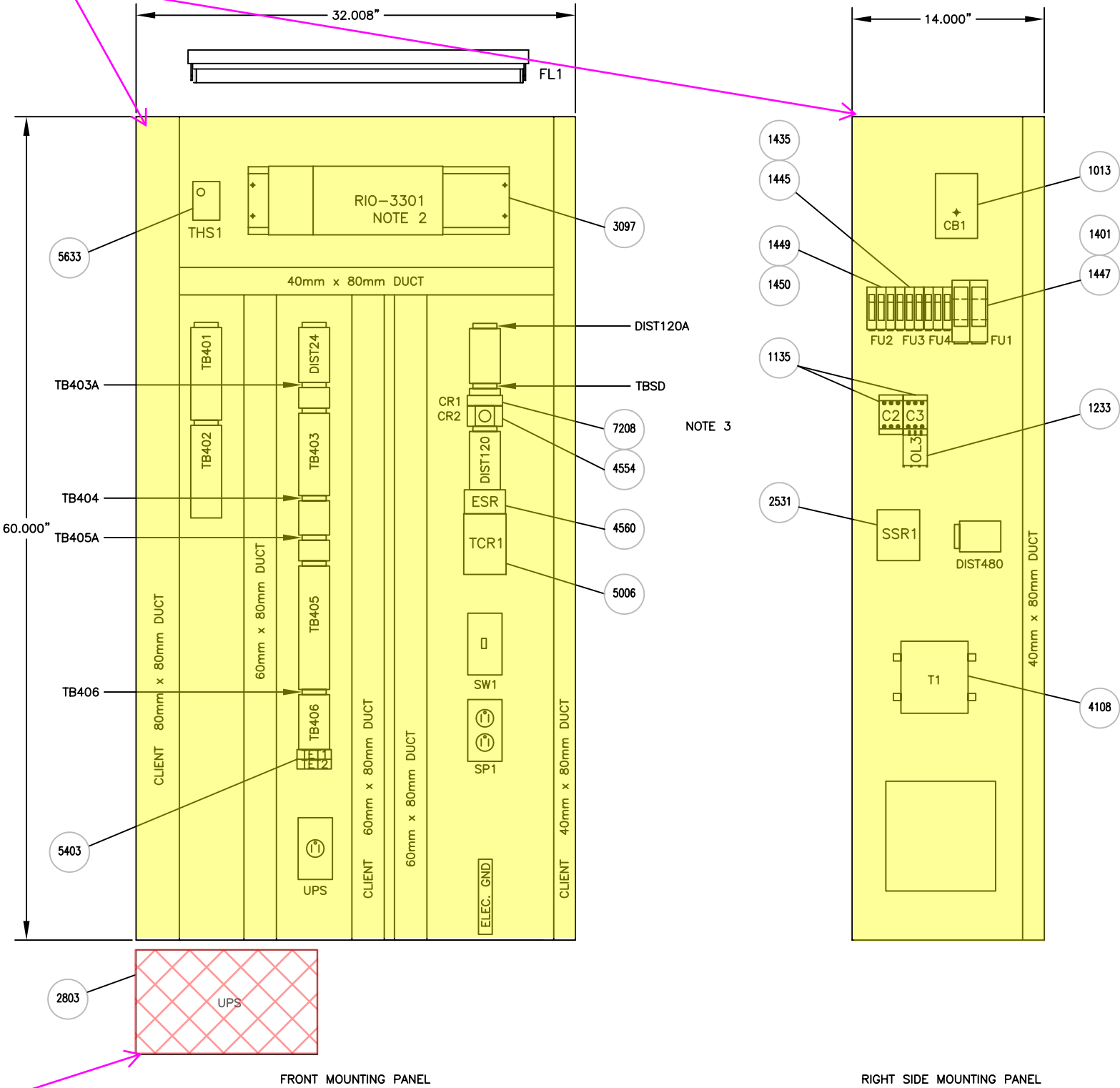
PLOT COLORS IN BLACK EXCEPT 253
P04_R08/AUTOCAD 16.0
SCALE: 1in.=1ft. PLOT: 1=12
IMALOG PROJECT No: M-0694



OZONE DESTRUCT CONTROL PANEL
LAYOUT DRAWING
EXTERNAL DETAIL

DWG No: 0694-TE-014	PAGE 1	REV 3

Back & side panels and mounted components will be completely replaced.



NOTES

- ALL DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED
1. FOR ITEM NUMBERS, SEE DRAWING 0694-TS-014 PAGE 5 AND 6
 2. FOR PLC'S DETAIL, SEE PAGE 5
 3. CR1 APPLY TO CP-33001 ONLY

FINAL ISSUE
2007-07-19

5	07-07-18	CS	VT
4	07-01-08	YW	VT
3	06-11-07	YW	VT
2	06-10-18	CS	VT
REV	DATE	DRAWN	CHECKED

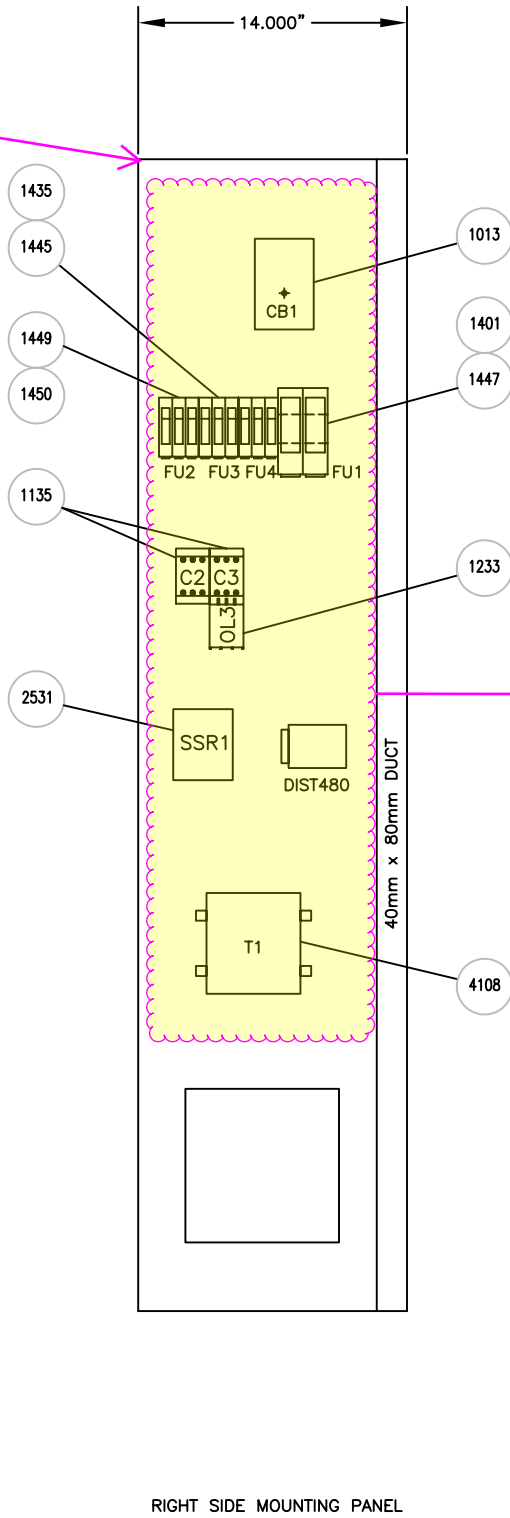
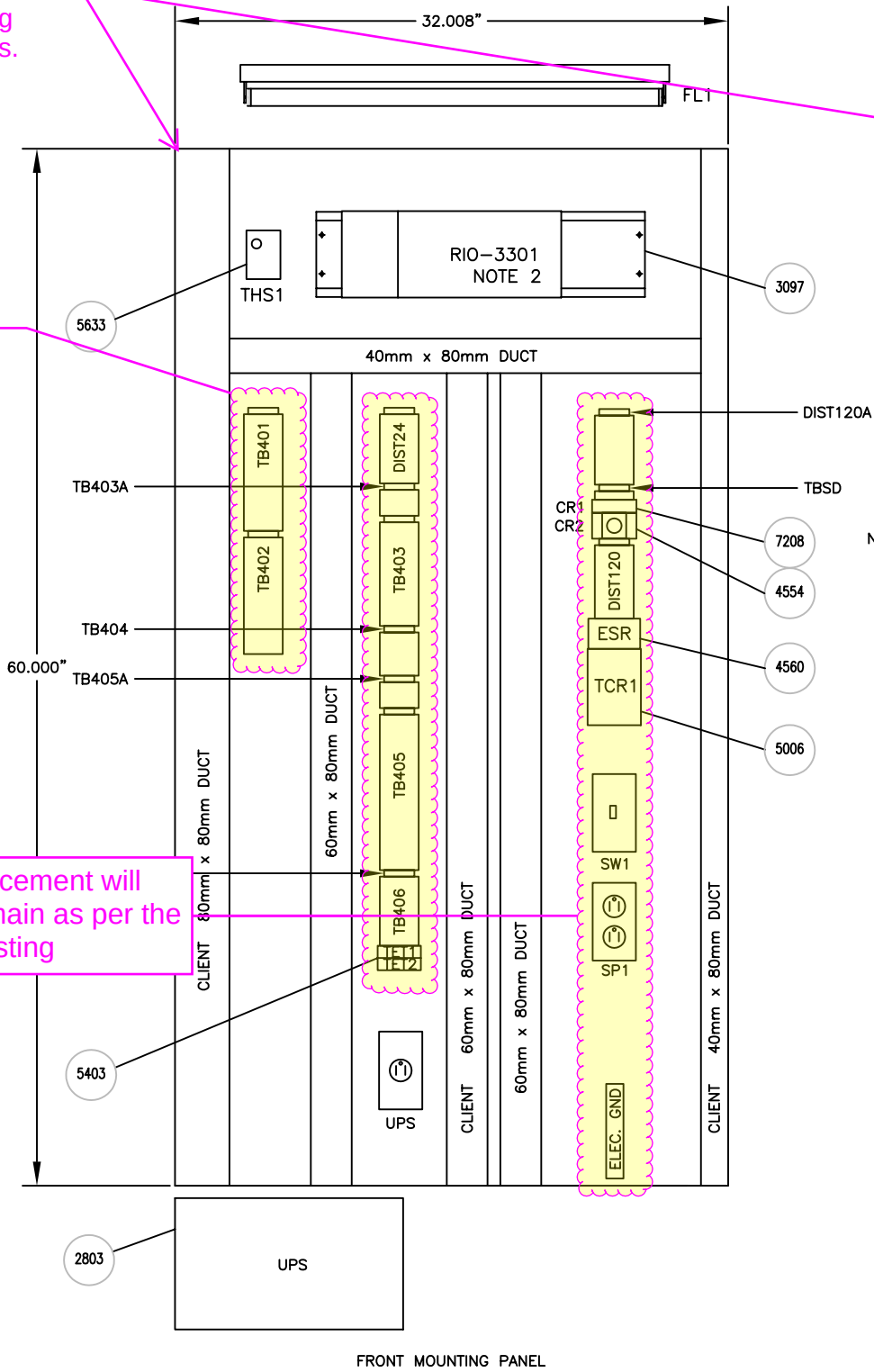
REVISED AS BUILT

Non-highlighted mounted components will either be eliminated or replaced, depending on their use and needs.

Placement will remain as per the existing

Placement will remain as per the existing

Placement will remain as per the existing



NOTES

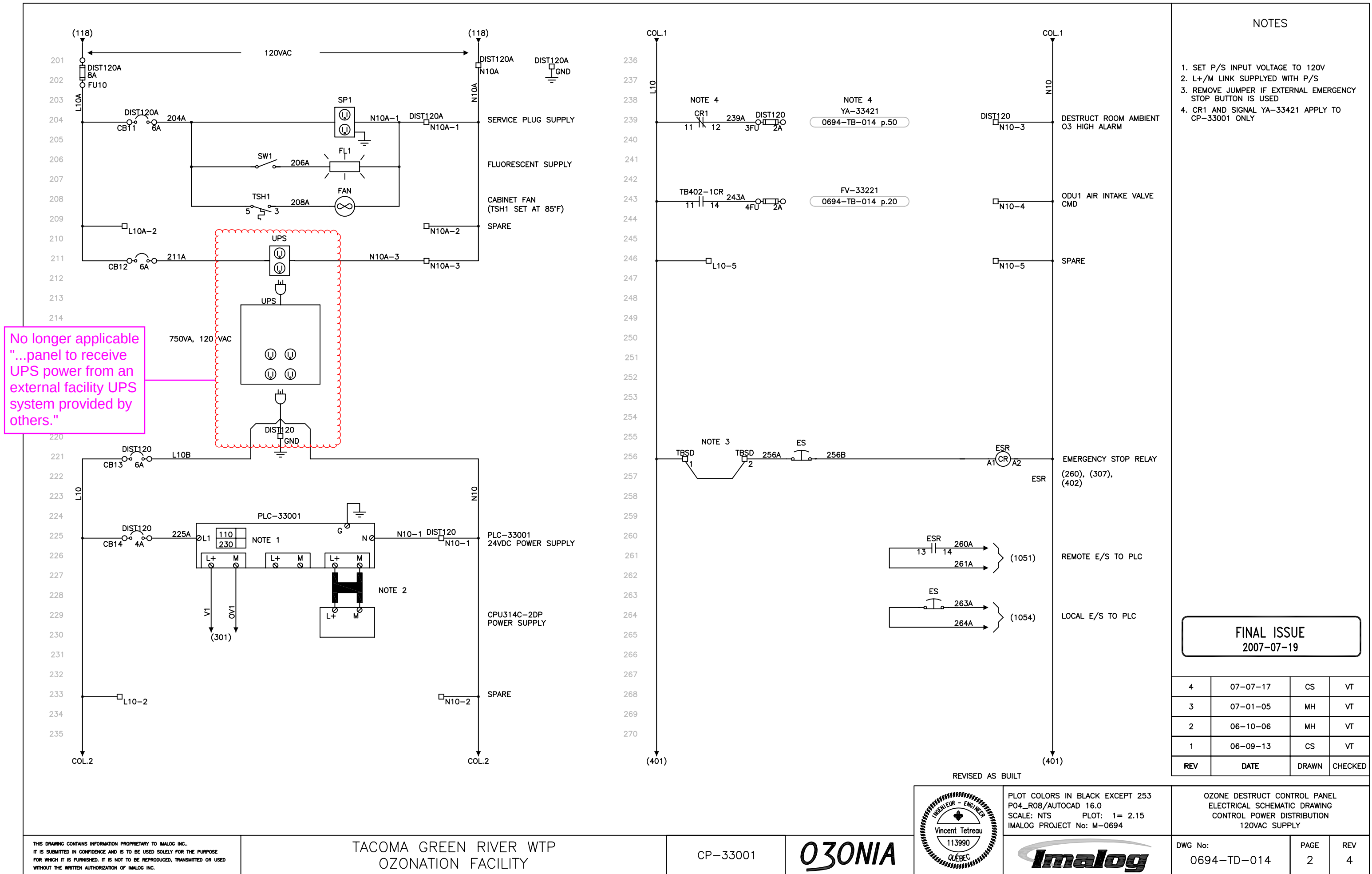
- ALL DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED
1. FOR ITEM NUMBERS, SEE DRAWING 0694-TS-014 PAGE 5 AND 6
 2. FOR PLC'S DETAIL, SEE PAGE 5
 3. CR1 APPLY TO CP-33001 ONLY

Placement will remain as per the existing

FINAL ISSUE
2007-07-19

5	07-07-18	CS	VT
4	07-01-08	YW	VT
3	06-11-07	YW	VT
2	06-10-18	CS	VT
REV	DATE	DRAWN	CHECKED

REVISED AS BUILT



APPENDIX A



Scope Letter

S&B inc. 13200 SE 30th St., Bellevue, Washington 98005 (425) 644-1700 FAX (425) 746-9312

March 27, 2026

Tacoma Water
via Bid Documents Appendix A Information

Attn: All Bidding Contractors
Subject: Tacoma Water
GRFF Ozone System Replacement
PIC Integrator Scope of Supply & Fee

Dear Bidding Contractors:

S&B is serving as the PIC Integrator for the project. The fee for the PIC Integrator scope is included within the project contract bid form. This scope letter will provide clarity to the Contractor of what is being supplied and known coordination points.

S&B is providing several key categories of equipment in the I&C system (as noted below). Details on this scope of supply are found in the following sections.

1. Headworks Control Panel (CP-11000)
2. Sample Station Back Panels + HMIs (5x)
3. Loose Communications Equipment for existing Comm panels (3x)
4. New MCC Buckets sections, breakers, and Power Meters
5. Sodium Bisulfite VFDs & Flow Meters
6. SCADA Coordination with OSS

New Headworks Panel

A new, 3-bay wide, control panel is supplied as the new Headworks Panel (CP-11000). This panel serves as the controller for all Remote IO panels at the Sample Stations. The panel features a new Redundant PLC, redundant power supplies, and redundant network connected remote IO chassis.

Designed for Future Cutover

S&B is designing the new headworks panel to accommodate not only the new sample stations with this project, but also IO and equipment mounting locations for future cutover projects to allow the City to fully transition from the existing panel to the new panel. This new headworks panel features:

- Redundant PLC in far right bay
- Fiber Termination patch panel

- I/O in far left bay, designed for overhead conduits

Required Spares

S&B is supplying the required spares as per 40 90 00 – 1.09 – B&D

Shop Test

S&B will perform a shop demo of the Headworks Panel connected to the Sample Station Panels and HMIs, as a complete system in S&B's shop. Tacoma Water is invited to witness the test, as well as Jacobs.

Startup

The Headworks panel must be the first panel to be commissioned, as it is the PLC to process all IO for the sample stations. S&B will perform the startup of the panel, and then commission all subsequent sample station panels that are brought online.

Training

Training is provided per 40 90 00-3.05-B-2&3

Known Coordination & Scope to be Fulfilled by Contractor

The Contractor is responsible for the associated tasks related to the Headworks Control Panel scope:

- Temperature Control of control panel equipment when in storage
- All required electrical studies related to control panel equipment (if applicable)
- Ensure the startup of the Headworks panel is performed and completed before the startup of any sample stations panels.
- Ensure startup activities are scheduled only AFTER all electrical wiring is fully completed
- Ensure S&B is the entity to initially power-up the PLC control panel to minimize risk

New Sample Station PLC Control Panels (back panels & HMIs)

The five existing sample stations control panels will receive new back panels and HMIs (as shown on Plans 08-I-321 and 08-I-323). S&B will supply all five panels, HMIs, (and associated application software located in the headworks panel and SCADA graphics computers) as part of this contact. This includes the following panels:

- CP-36001 (Sample Station 1): new back panel + 12" HMI
- CP-36002 (Sample Station 2): new back panel + 12" HMI
- CP-36003 (Sample Station 3): new back panel + 12" HMI
- CP-36004 (Sample Station 4): new back panel + 12" HMI
- CP-36005 (Sample Station 5): new back panel + 12" HMI

Like-for-Like Replacement of Panel Design

The new control panels will be a like-for-like replacement as the existing. This includes the following examples:

- The new back panels will be constructed to allow for field wiring to be landed in similar location as the existing, to minimize the requirement of butt-splicing field wires, but some splices may be required.

- The remote IO interface modules will be redundant units, connected via Fiber --> Profinet with single IO modules
- Space is left for existing panel equipment to be remain / remounted in panel. This includes
 - Fiber Termination Box
 - Cisco switch
- UPS unit supplied for mounting on bottom of cabinet
- New 12" HMI touch panel. (Contractor must cut door to updated rectangle size as per submittal information for door cutouts).

Required Spares

S&B is supplying the required spares as per 40 90 00 – 1.09 – D

Delivery of Panels to Jobsite

S&B shall deliver the all Sample Station panels, with the new Headworks panel, in a single shipment to the jobsite. The Contractor shall be responsible all unloading, onsite movement, and thermally controlled storage to ensure no moisture or dew damages the electronics.

Startup Support

During startup, S&B shall perform the initial panel powerup after the field wiring is complete. S&B will verify connectivity to the associated redundant PLC in the new Headworks panel and the SCADA system. S&B will verify the new Ozone and Flow instrument signals are received and processes. Be aware, for all new field devices at the sample stations, the instrument vendor is required to be onsite to setup the field instrument's span during startup, and S&B shall verify the output is read by the remote IO panel.

S&B will also made the required application software edits to the existing headworks panel to remove the sample station connections and logic, each time a sample station is transitioned from the old panel to the new panel.

Known Coordination & Scope to be fulfilled by Contractor

The Contractor is responsible for the associated tasks related to the Sample Station Control Panel scope:

- Temperature Control of new back panel equipment when in storage
- All required electrical studies related to control panel equipment (if applicable)
- Remove of existing panel equipment as per Contract Specifications
- Installing back panel + HMI into existing enclosure, and re-terminating all field wires to terminals as per wiring schematics
- Re-Installing required salvaged equipment (fiber termination box, fiber jumpers, and Cisco switches)
- Ensure instrument suppliers have provided the instrument's calibrated range for all 4-20mA signals to in their submittal to allow for the PLC code to be written to match the instrument's span.
- Ensure startup activities are scheduled only AFTER all electrical wiring is fully completed
- Ensure S&B is the entity to initially power-up the remote IO panel to minimize risk
- Ensure instrument suppliers are onsite to set all field device instrument spans, settings, etc. at the same time as planned control panel commissioning to support the field devices side of the field connections

New Equipment (Supplied Loose) for Mounting in Existing Communications Panels

S&B is supplying new communication equipment, specific to the Ozone System Supplier's automation network communications, which must be paired to the existing fiber optic equipment. S&B is responsible for hardware supply only, but the OSS will be responsible for the exact configuration to pair with their control panel automation equipment so the Ozone deliverable can work as a complete system across the wide-area Ozone Automation network. Each comm panel includes the following type of devices

- Y-Switch
 - With Bus Adapters for associated media
- Scalance Switches (models and quantities per 40 90 00-2.05-A)
 - With SFP Modules for associated media
- PN/PN Coupler
- Power Supply (to support the increased 24Vdc load with the new switches)

Coordination with OSS

S&B will coordinate with the Ozone System Supplier (OSS) on the hardware to allow for the configuration to be coordinated and allow for the OSS' application engineers program the hardware into their Ozone system network. This coordination is paramount so that the OSS can have a linked system across the plant. The hardware (initial setup) will be documented and handed to the contractor for field installation, so the OSS can add the hardware components into their hardware configuration within the programming platform and finalize their startup activities.

Startup

After installation, S&B will power up the hardware and ensure it is in working order. This is the demark of responsibility, as after it is deemed working, the OSS will take responsibility to connect, adjust any pre-configured setup, and commission it as it relates to their oval WAN Ozone network.

New MCC Bucket Sections

S&B is supplying the MCC hardware related to three existing MCCs. Three existing MCCs will receive new MCC Buckets sections and a single power meter, and some sections receive new breakers. This includes the following MCCs:

- 31 MCC 01 – Ozone Generation
- 32 MCC 01 – Ozone Injection
- 33 MCC 01 – Ozone Destruct

In applications of larger breakers, a new breaker and disconnect handle apparatus are supplied for the contractor to replace like-for-like in the field.

Motor Starter Wiring Diagrams

S&B shall work with the Siemens MCC group to establish new MCC wiring diagrams for the new bucket sections. These new bucket sections will technology migrations of the existing motor starter diagrams (which S&B has), but utilize a new 3UF7 Simocode and Profinet communication.

Motor Starter Shop Test

S&B shall shop test each motor starter prior to shipment to the jobsite. This will include:

- Verify Wiring of buckets against factory Drawings
- Configuration of the Simocode Smart Overload Device
 - Profinet Name
 - IP Address
 - Motor Nameplate data
 - Verification of FW v3.0.0 or greater on hardware, required for S2 redundancy applications
 - (implementation of S2 redundancy with connection to the associated PLC is performed within the PLC code and provided by the Ozone system supplier, as they establish the PLC logic of the overall application).

Required Spares

S&B is supplying the required spares as per 26 24 19 – 3.04 - A

Remote Coordination with OSS

The Shop test will be coordinated with Veolia (Ozone System Supplier) to allow them to witness via Teams Meeting, the connectivity of each motor starter and power meter, proving the Profinet communications works for each device. Additionally, S&B will setup a VPN connection to allow for the OSS to setup the network switches for the ring configuration.

Delivery of MCCs to Jobsite

S&B shall deliver all MCC equipment in a single shipment to the jobsite. The Contractor shall be responsible all unloading, onsite movement, and thermally controlled storage to ensure no moisture or dew damages the electronics.

Startup Support

During startup, S&B shall support the MCC hardware within the new buckets to ensure the Simocode units, and power meters are configured. But the OSS is responsible for the commissioning of the networked connected functionality of all units when commanded by the PLCs supplied by the OSS.

Known Coordination & Scope to be fulfilled by Contractor

The Contractor is responsible for the associated tasks related to the MCC scope:

- Temperature Control of new MCC equipment
- All required electrical studies related to MCC equipment
- All required breaker testing related to MCC equipment
- Applying all required breaker settings to MCC equipment
- Coordinating the installation of associated network switch and Y-switch equipment in the COMM panels (as per DWG 08-I-202).

VFDs and Flow Meters for Sodium Bisulfite Feed System

Two (2) flow meters, and four (4) VFDs related to the existing Sodium Bisulfite system are being upgraded with new versions of the same equipment. Both the flow meters and VFDs are integral to the existing Profibus communications network that is to remain operational. S&B is supplying the flow meters and VFDs to ensure each device is correctly configured and tested prior to shipment to jobsite to improve the commissioning process. The scope of supply includes the following equipment:

- Flow Meters (2x)
 - FE/FIT-26241
 - FE/FIT-26242
- VFDs (4x)
 - VFD-26221
 - VFD-26222
 - VFD-26223
 - VFD-26224

Like-for-Like Replacement

The new VFDs are a like-for-like replacement of the existing, using the current model from the City's preferred MFG. The new unit is a 240Vac, 1HP drive with a Profibus connection. Additionally, a new motor start protector is also supplied.

The mag meters are supplied to match the City's standard make/model. The Profibus connection must be re-connected to the meter. They will be supplied with ½" MNPT connections, like all other meters in their chemical area.

Harmonic Analysis

S&B will perform a harmonic analysis of just the 4 VFDs supplied for the project. The report will be submitted to Jacobs as a submittal, and used as an input to be evaluated by the Tacoma Water staff. But with the specified VFD, being a 6-pulse unit, any mitigating action as a result of the analysis is excluded from our scope of supply.

Startup

S&B must configure the Profibus network connection to the processor for both the VFDs and Flow meters. After the network connection is established, S&B will perform functional testing of the existing chemical feed system in auto mode.

Known Coordination & Scope to be fulfilled by Contractor

The Contractor is responsible for the associated tasks related to the Sodium Bisulfite scope:

- Send submittal literature on the new pumps to S&B to ensure the new VFD matches the motor nameplate
- Installing new chemical flow meter (ensuring it is mounted at the bottom of the loop, or in a vertical orientation, to ensure reliability and accuracy)

- Installing new VFDs and MSPs in the existing PACL enclosure
- All required breaker testing related to new motor starter protectors (MSPs) added in panel

SCADA Coordination with OSS

Initial Delivery to OSS

S&B is providing SCADA coordination with the Ozone System Supplier (OSS), Veolia. S&B will provide an initial “Seed” project file to Veolia to help develop the SCADA application for their scope of work so it can be brought into the existing overall Plant SCADA. The Contractor does not need to coordinate this, but they can be aware of what is happening. S&B will provide the following as per Spec section 40 99 90 – 5 & 6)

- Seed Project
 - Project File with a PLC connection to the Main Panel and both Generator Panels
 - Example Tag Archiving setup for historical data acquisition
 - Example Alarm and Event items
 - Example folder for all Ozone screens to reside
 - Example Screen with correct aspect ratio and common colors for Pumps, Valves, etc., and correct naming conventions for future import. Screen will include buttons with correct permissions hierarchy so it can be applied throughout the project
 - Example pop-up with correct naming for future import
 - Excel file of exported tags of existing ozone system
- Teams Meeting to Review project file and answer questions for development team. (OSS is encouraged to record the meeting for better recall of information)

SCADA Project Review #1

To minimize potential re-work, S&B will have an initial review meeting with the OSS team’s SCADA designer to check the initial project configuration, and provide recommendations to improve the development so it can be more seamlessly brought into the existing project. This will be a Teams Meeting review of the SCADA System.

SCADA Project Ingestion & Installation

S&B will take the SCADA archive from the OSS and perform a final review of the contents. Corrective comments will be sent back to the OSS if changes are required. An approved project archive will be imported into the existing SCADA project by S&B. S&B technical staff will bring in the screens, tags, tag archives, and alarm/events. S&B will then update the menu to allow for navigation to the new Ozone screens built by the OSS.

S&B will then download the compiled project file (existing Plant + new Ozone system) at the Plant ahead of the commissioning effort. S&B will also install the additional software licenses in the SCADA computer to ready the system for the new PLCs and data points to be monitored.

After commissioning, S&B will remove the links to screens of the previous Ozone screens.

Pricing:

The pricing for the scope of work, as defined in this quote letter, is as follows.

\$1,397,760.00

Pricing is valid for 30 days after the award of the bid to the General Contractor.

Standard Inclusions:

- Award based on a purchase order issued.
- Equipment is factory tested and shipped FOB factory with freight allowed, common carrier, destination.
- Shop Drawings, instruction manuals and software documentation via electronic media.
- Submittal Documentation per specifications
- Field Engineering Services for technical support of installation questions, start-up, and acceptance testing of equipment supplied by this quotation. S&B is a designer and supplier of control system equipment, providing technical support and engineering services to review installation of our equipment, commission and attest to its compliance with the project specifications.
- Quote is valid for thirty days

Standard Exclusions:

Unless specifically included as a line item in this quotation's scope of supply the following are excluded from our scope of deliverables:

- Tariffs
- State and local sales tax
- Installation costs and any associated permits
- Stamped seismic calculations for Seismic Zone compliance.
- Arc Flash studies and/or labeling
- Short Circuit and circuit breaker trip coordination studies
- 3rd party circuit breaker certification testing and certification
- Piping, tubing, valves, fittings between the instruments and the process
- Process appurtenances: Pumps, pressure gauges, manifolds, bushings, thermowells, diaphragms, annular seals, purge assemblies, stilling wells, valves, pump over-temp sensors, pump moisture sensors, or solenoids that are not an integral part of the listed scope.
- Conduit, wire or cable external to the control system panels listed in this scope
- Mounting brackets, stanchions, supports, pads that are not integral to the control system panels or process instruments listed in this scope.
- Liquidated damages (available upon request and definition of scope)
- Subcontract (available for additional cost). This includes costs associated with certified payroll submission, EEO reports, completion of Affidavit of Wages paid.
- Bonding (service available for additional fee)
- Credit Card payment
- Equipment or services not specifically listed in our scope of work

We look forward to the opportunity to work on this important project and will contribute to making this successful by delivering the highest quality of materials and startup services according to the agreed schedule. Please feel free to contact us regarding any questions that you may have regarding our quotation.

Yours very truly,

A handwritten signature in black ink, appearing to read 'Jordan Stead', with a stylized, cursive script.

Jordan Stead
Business Development
S&B Inc.

PREVAILING WAGE RATES

This project requires prevailing wages under [39.12 RCW](#). Any worker, laborer, or mechanic employed in the performance of any part of the work shall be paid not less than the applicable prevailing rate of wage.

The project site is located in King County.

The effective date for prevailing wages on this project will be the **submittal deadline** with these exceptions:

- a. If the project is not awarded within six months of the submittal deadline, the award date is the effective date.
- b. If the project is not awarded pursuant to a competitive solicitation, the date the contract is executed is the effective date.
- c. Janitorial contracts follow WAC 296-127-023.

Except for janitorial contracts, these rates shall apply for the duration of the contract unless otherwise noted in the solicitation.

Look up prevailing rates of pay, benefits, and overtime codes from this link:

<https://secure.lni.wa.gov/wagelookup/>

REQUIRED FILINGS

The contractor and all subcontractors covered under [39.12 RCW](#) shall submit to the Department of Labor and Industries (L&I) for work provided under this contract:

1. A Statement of Intent to Pay Prevailing Wages must be filed with and approved by L&I upon award of contract.
2. An Affidavit of Wages Paid must be filed with and approved by L&I upon job completion.

Payments cannot be released by the City until verification of these filings are received by the engineer. Additional information regarding these filings can be obtained by calling the Department of Labor & Industries, Prevailing Wage at 360-902-5335, <https://www.lni.wa.gov/> or by visiting their MY L&I account.



CITY OF TACOMA INSURANCE REQUIREMENTS FOR CONTRACTS

This Insurance Requirements shall serve as an attachment and/or exhibit form to the Contract. The Agency entering a Contract with City of Tacoma, whether designated as a Supplier, Contractor, Vendor, Proposer, Bidder, Respondent, Seller, Merchant, Service Provider, or otherwise referred to as “Contractor”.

1. GENERAL REQUIREMENTS

The following General Requirements apply to Contractor and to Subcontractor(s) performing services and/or activities pursuant to the terms of this Contract. Contractor acknowledges and agrees to the following insurance requirements:

- 1.1. Contractor shall not begin work under the Contract until the required insurance has been obtained and approved by the City of Tacoma.
- 1.2. Contractor shall keep in force during the entire term of the Contract, at no expense to the City of Tacoma, the insurance coverage and limits of liability listed below and for Thirty (30) calendar days after completion of all work required by the Contract, unless otherwise provided herein.
- 1.3. Liability insurance policies, except for Professional Liability and Workers’ Compensation, shall:
 - 1.3.1. Name the City of Tacoma and its officers, elected officials, employees, and agents as **additional insured**
 - 1.3.2. Be considered primary and non-contributory for all claims with any insurance or self-insurance or limits of liability maintained by the City of Tacoma
 - 1.3.3. Contain a “Waiver of Subrogation” clause in favor of City of Tacoma
 - 1.3.4. Include a “Separation of Insureds” clause that applies coverage separately to each insured and additional insured
 - 1.3.5. Name the “City of Tacoma” on certificates of insurance and endorsements and not a specific person or department
 - 1.3.6. Be for both ongoing and completed operations using Insurance Services Office (ISO) form **Both** CG 20 10, or CG 20 26, or CG 20 33, **10 01 Editions**, or
 - 1.3.7. CG 20 38 04 13 or the equivalent
 - 1.3.8. Be satisfied by a single primary limit or by a combination of a primary policy and a separate excess umbrella
- 1.4. A notation of coverage enhancements on the Certificate of Insurance shall not satisfy these requirements below. Verification of coverage shall include:
 - 1.4.1. An ACORD certificate or equivalent
 - 1.4.2. Copies of requested endorsements (Additional Insured, Waiver of Subrogation, Primary and non-contributory) specifically issued by the insurance carriers evidencing coverage on the certificate
- 1.5. Contractor shall provide to City of Tacoma Procurement & Payable Division, prior to the execution of the Contract, Certificate(s) of Insurance and endorsements from the insurer certifying the coverage of all insurance required herein.



CITY OF TACOMA INSURANCE REQUIREMENTS FOR CONTRACTS

Contract or Permit number and the City of Tacoma Department must be shown on the Certificate of Insurance.

- 1.6. A renewal Certificate of Insurance shall be provided electronically prior to coverage expiration via email sent annually to coi@tacoma.gov.
- 1.7. Contractor shall send a notice of cancellation or non-renewal of this required insurance within Thirty (30) calendar days to coi@tacoma.gov.
- 1.8. "Claims-Made" coverages, except for pollution coverage, shall be maintained for a minimum of three years following the expiration or earlier termination of the Contract. Pollution coverage shall be maintained for six years following the expiration of the Contract. The retroactive date shall be prior to or coincident with the effective date of the Contract.
- 1.9. Each insurance policy must be written by companies licensed or authorized (or issued as surplus line by Washington surplus line broker) in the State of Washington pursuant to RCW 48 with an (A-) VII or higher in the A.M. Best key rating guide.
- 1.10. Contractor shall not allow any insurance to be cancelled, voided, suspended, or reduced in coverage/limits, or lapse during any term of this Contract. Otherwise, it shall constitute a material breach of the Contract.
- 1.11. Contractor shall be responsible for the payment of all premiums, deductibles and self-insured retentions, and shall indemnify and hold the City of Tacoma harmless to the extent such a deductible or self-insured retained limit may apply to the City of Tacoma as an additional insured. Any deductible or self-insured retained limits in excess of Twenty-Five Thousand Dollars (\$25,000) must be disclosed and approved by City of Tacoma Risk Manager and shown on the Certificate of Insurance.
- 1.12. City of Tacoma reserves the right to review insurance requirements during any term of the Contract and to require that Contractor make reasonable adjustments when the scope of services changes.
- 1.13. All costs for insurance are included in the initial Contract and no additional payment will be made by City of Tacoma to Contractor.
- 1.14. Insurance coverages specified in this Contract are not intended and will not be interpreted to limit the responsibility or liability of Contractor or Subcontractor(s).
- 1.15. Failure by City of Tacoma to identify a deficiency in the insurance documentation or to verify coverage or compliance by Contractor with these insurance requirements shall not be construed as a waiver of Contractor's obligation to maintain such insurance.



CITY OF TACOMA

INSURANCE REQUIREMENTS FOR CONTRACTS

- 1.16. If Contractor is a government agency or self-insured for any of the above insurance requirements, Contractor shall be liable for any self-insured retention or deductible portion of any claim for which insurance is required. A certification of self-insurance shall be attached and incorporated by reference and shall constitute compliance with this Section.

2. SUBCONTRACTORS

It is Contractor's responsibility to ensure that each subcontractor obtain and maintain adequate liability insurance coverage that applies to the service provided. Contractor shall provide evidence of such insurance upon City of Tacoma's request. Failure of any subcontractor to comply with insurance requirements does not limit Contractor's liability or responsibility.

3. REQUIRED INSURANCE AND LIMITS

The insurance policies shall provide the minimum coverages and limits set forth below. Providing coverage in these stated minimum limits shall not be construed to relieve Contractor from liability in excess of such limits.

3.1 Commercial General Liability Insurance

Contractor shall maintain Commercial General Liability Insurance policy with limits not less than One Million Dollars (\$1,000,000) each occurrence and Two Million Dollars (\$2,000,000) annual aggregate. This policy shall be written on ISO form CG 00 01 04 13 or its equivalent and shall include product liability especially when a Contract is solely for purchasing supplies or products. It includes Products and Completed Operations for three years following the completion of work related to performing construction services. It shall be endorsed to include: A per project aggregate policy limit (using ISO form CG 25 03 05 09 or equivalent endorsement) and/or Contractual Liability-Railroad using ISO form CG 24 17 10 01 or equivalent if Contractor is performing work within Fifty (50) feet of a City of Tacoma railroad right of way.

3.2 Commercial (Business) Automobile Liability Insurance

Contractor shall maintain Commercial Automobile Liability policy with limits not less than One Million Dollars (\$1,000,000) each accident for bodily injury and property damage and bodily injury and property damage coverage for owned (if any), non-owned, hired, or leased vehicles. Commercial Automobile Liability Insurance shall be written using ISO form CA 00 01 or equivalent. Contractor must also maintain MCS 90 and CA 99 48 endorsements or equivalent if "Pollutants" are to be transported unless in-transit Pollution coverage is covered under required Contractor's Pollution Liability Insurance.

3.3 Workers' Compensation

Contractor shall comply with Workers' Compensation coverage as required by the Industrial Insurance laws of the State of Washington, as well as any other similar coverage required for this work by applicable federal laws of other states. Contractor must comply with their domicile State Industrial Insurance laws if it is outside the State of Washington.

3.4 Employers' Liability Insurance

Contractor shall maintain Employers' Liability coverage with limits not less than One Million Dollars (\$1,000,000) each employee, One Million Dollars (\$1,000,000) each accident, and One Million Dollars (\$1,000,000) policy limit.



CITY OF TACOMA

INSURANCE REQUIREMENTS FOR CONTRACTS

3.5 Excess or Umbrella Liability Insurance

Contractor shall provide Excess or Umbrella Liability Insurance with limits not less than Five Million Dollars (\$5,000,000) per occurrence and in the aggregate. This coverage shall apply, at a minimum, in excess of primary underlying Commercial General Liability, Employer's Liability, Pollution Liability, Marine General Liability, Protection and Indemnity, and Automobile Liability if required herein.

3.6 Cyber/Privacy and Security Insurance

Cyber Liability Insurance, with limits not less than \$2,000,000 per occurrence or claim, \$2,000,000 aggregate. Coverage shall be carried by the Contractor or the Process and Instrumentation Systems Integrator (PICS) sufficiently broad to respond to the duties and obligations as is undertaken by Contractor in this agreement and shall include, but not be limited to, claims involving security breach, system failure, data recovery, business interruption, cyber extortion, social engineering, infringement of intellectual property, including but not limited to infringement of copyright, trademark, trade dress, invasion of privacy violations, information theft, damage to or destruction of electronic information, release of private information, and alteration of electronic information. The policy shall provide coverage for breach response costs, regulatory fines and penalties as well as credit monitoring expenses.

3.7 Commercial Property Insurance

Contractor shall provide Commercial Property Insurance for loss or damage to any and all equipment owned by City of Tacoma while in the care, custody, or control of Contractor, Subcontractors, or their agents. The coverage shall be provided on an ISO **Special Form Causes of Loss** CP10 30 06 07 or equivalent and shall provide full replacement cost coverage. The deductible shall not exceed Two Thousand Five Hundred Dollars (\$2,500). Contractor shall be responsible for paying the deductible for the applicable coverage.

3.8 Installation Floater Insurance

Contractor shall maintain during the term of the Contract, at its own expense, Installation Floater Insurance covering Contractor's labor, materials, and equipment to be used for completion of the work performed under this Contract against all risks of direct physical loss, excluding earthquake and flood, for an amount equal to the full amount of the Contract improvements.

3.9 Builder's Risk Insurance

Contractor shall maintain during the term of the Contract and until final acceptance of the work by the City of Tacoma, a policy of Builder's Risk Insurance providing coverage for all-risk of physical injury to all structures to be constructed according to the Contract. City of Tacoma shall be included as a named insured (not named as additional insured) on the policy. Builder's Risk Insurance policy shall:

- 3.9.1 Have a deductible of no more than Five Thousand Dollars (\$5,000) for each occurrence, the payment of which will be the responsibility of Contractor. Any increased deductibles accepted by City of Tacoma will remain the responsibility of Contractor
- 3.9.2 Be on an ISO Special Form Causes of Loss or the equivalent and also include coverage for Collapse, Earthquake and Flood. The deductible for Earthquake and Flood may be higher than the \$5,000 deductible required in 3.18.1.



CITY OF TACOMA INSURANCE REQUIREMENTS FOR CONTRACTS

- 3.9.3 Include coverage for temporary buildings, debris removal, and damage to materials in transit or stored off-site
- 3.9.4 Be written in the amount of the completed value of the structures, with no coinsurance provisions exposure on the part of Contractor or City of Tacoma
- 3.9.5 Contain a Waiver of Subrogation provision whereby each insured waives their subrogation rights to the extent the loss is covered by this insurance
- 3.9.6 Grant permission to occupy, allowing the building or structure to be partially occupied prior to completion, without detrimental effect to the coverage provided
- 3.9.7 Include coverage for the testing and startup of the building's operating systems
- 3.9.8 Include coverage for City of Tacoma's loss of use or business interruption arising out of a covered loss which delays completion
- 3.9.9 Include resultant damage coverage for loss due to faulty workmanship and defective material
- 3.9.10 Include coverage for startup and testing
- 3.9.11 Include coverage for resultant damage coverage for loss due to faulty workmanship and defective material

Contractor and City of Tacoma waive all rights against each other, their respective subcontractors, agents, and representatives for damages caused by fire or other perils to the extent covered by Builder's Risk Insurance or other property insurance applicable to the work. The policies shall provide such waivers by endorsement or otherwise.

3.10 Inland Marine (Cargo) Insurance

Contractor shall maintain Cargo Insurance. Coverage shall protect the property from all risk of injury, and coverage shall be in an amount of the full replacement cost of the property, with no coinsurance exposure. Any applicable deductible shall not exceed Five Thousand Dollars (\$5,000).

3.11 Other Insurance

Other insurance may be deemed appropriate to cover risks and exposures related to the scope of work or changes to the scope of work required by City of Tacoma. The costs of such necessary and appropriate Insurance coverage shall be borne by Contractor.