

Project Manual

Well Nos. 7-9 Water Treatment Plant Improvements for Well No. 8

Elk River Municipal Utilities
Elk River, MN

SEH No. ELKMU 192017

August 14, 2026



Building a Better World
for All of Us®

Engineers | Architects | Planners | Scientists

REQUEST FOR BIDS

PROJECT: Treatment Plant 7 Modifications

DATE: October 9, 2026

BIDS RECEIVED

Elk River Municipal Utilities, Elk River, Minnesota, will receive sealed bids until **11:00 A.M. Tuesday, October 20, 2026**, to furnish Labor and Material to construct the Treatment Plant 7 Modifications as more fully described in the specifications. Bids will be opened and read at that time at the address noted below.

Bids should be addressed:

Dave Ninow, Water Superintendent
Elk River Municipal Utilities
13069 Orono Parkway
P.O. Box 430
Elk River, MN 55330

Email: dninow@ermumn.com

Bids can be sent by email with the subject line indicating: **Bid for Treatment Plant 7 Modifications**. The bid should be provided in an attachment to the email with no bid details provided in the body/text of the email other than contractor information. The attachment will not be opened until the designated bid opening time.

If the bid is submitted by email the attachment should include the executed Bid Form and Responsible Contractor Certification Forms. If the bid is submitted by mail or in person, the Bid Form and Responsible Contractor Certification Forms should be contained within a sealed envelope.

DESCRIPTION OF PROJECT

The Treatment Plant 7 Modifications project in the City of Elk River consists of demolition, relocation of existing equipment, and installation of new piping as indicated in the plans and specifications to allow for the treatment of water from Well Number 8.

LATE BIDS

Bids received after the time set for the opening of the bids will be returned to the bidder unopened.

REJECTION OF BIDS

The Elk River Municipal Utilities Commission reserves the right to reject all bids and waive all technicalities. The project will be awarded to the lowest responsible and responsive bidder.

PROJECT AWARD

It is Elk River Municipal Utility's intent to award the project at their regularly scheduled meeting in November 2026 and the project must be completed by March 31, 2027. Once the Contractor has mobilized on site, work shall continue without interruption until the Improvements are completed and accepted. The Utility reserves the right to award within 60 days of the bid opening.

SPECIFICATIONS

Electronic plans and specifications detailing the work are attached and should be reviewed prior to submitting a bid.

BOND / LETTER OF CREDIT

The successful bidder must, at the time of the execution of the contract, provide Elk River Municipal Utilities a performance and payment Bond or irrevocable letter of credit pursuant to the requirements of Minnesota Statutes Section 574.26 to 574.32, as amended.

INTENT OF SPECIFICATIONS

The specifications are intended to describe the type of material and general features of design required. No substantial or material deviations from specifications, alterations or substitutions will be considered.

NON-COLLUSIVE BIDDING CERTIFICATIONS

By the submission of a bid, the bidder certifies that: (a) The bid has been arrived at by the bidder independently and has been submitted without collusion with any other vendor of materials, supplies, or equipment of the type described in the invitation for bids; and (b) The content of the bid has not been communicated by the bidder, nor to its best knowledge and belief by any of its employees or agents to any person not an employee or agent of the bidder or its surety on any bond furnished herewith, and will not be communicated to any such person prior to the official opening of the bid.

LIQUIDATED DAMAGES

Owner and Contractor recognize that the Owner will suffer financial loss if work is not completed within the time specified in the Specifications and Letting, plus any extensions thereof allowed. They also recognize the delays, expense, and difficulties involved in proving in a legal proceeding the actual loss suffered by the Owner if the work is not completed on time. Accordingly, instead of requiring any such proof, the Owner and Contractor agree that as liquidated damages for delay (but not as a penalty) the Contractor shall pay the Owner Five Hundred Dollars (\$500.00) for each day that expires after the time specified in the Specifications.

ENGINEER'S AUTHORITY

The Engineer may act as the Owner's representative during the construction period and may decide questions which may arise as to quality and acceptability of materials furnished and work performed, and shall interpret the intent of the Contract Documents in a fair and unbiased manner. The Engineer will make visits to the site and determine if the work is proceeding in accordance with the Contract Documents.

The Contractor will be held strictly to the intent of the Contract Documents in regard to the quality of materials, workmanship, and execution of the work. Inspections may be at the factory or fabrication plant of the source of material supply.

The Engineer will not be responsible for the construction means, controls, techniques, sequences, procedures, or construction safety.

The Engineer shall promptly make decisions relative to the Contract Documents and his decision shall be final.

PERMITS

A permit has been received from the Minnesota Department of Health. Coordination with the Department of Health to permit required inspections will be required as part of the project scope.

STANDARD CONTRACT:

Upon acceptance of a quotation by Elk River Municipal Utilities, the following form of agreement will be executed by the parties:

SAMPLE – CONSTRUCTION AGREEMENT – SAMPLE

This **CONSTRUCTION AGREEMENT (“AGREEMENT”)** is made this ___ day of _____, 202__, and is by and between Elk River Municipal Utilities, a Minnesota municipal utility (“Owner”), and _____, a _____ (“Contractor”).

RECITALS

A. The Owner issued a solicitation for quotations for the Treatment Plant 7 Modifications project (the “Solicitation Package”); and

B. The Solicitation Package described the specifications for the Treatment Plant 7 Modifications project (the “Work”); and

C. Contractor submitted a quotation in response to the Solicitation Package, which was accepted by the Owner.

NOW THEREFORE, in consideration of their mutual covenants, the Owner and Contractor agree as follows:

1. **SCOPE OF WORK.** Contractor agrees to provide, perform, and complete all of the provisions of the Work in accordance with the Project Manual, Plans, and the quotation package.

2. **COMPLETION DATE.** Contractor shall complete the Work to the Owner’s satisfaction and acceptance on or before March 31, 2027 (the “Completion Date”). Any extension of the Completion Date must be approved in writing by the Owner.

3. **TERMINATION.** Unless terminated prior to the Completion Date as provided in this Section 3, this Agreement shall terminate upon its own terms on the Completion Date, without any further action by the Owner or Contractor. Prior to the Completion Date, the Owner may terminate this Agreement for any reason following 30 days’ written notice to the Contractor. Upon such termination, Contractor shall quit the Work site, remove any Contractor property from the Work Site, and restore the Work site to the greatest extent possible. If the Owner terminated this Agreement prior to the Completion Date, Contractor shall be paid for any work completed prior to the Owner’s notice of termination.

4. **DOCUMENTS.** The following documents are all essential and component parts of this Agreement, and are incorporated into and made part of this Agreement:

- A. Solicitation Package;
- B. Plans and Project Specifications;
- C. City of Elk River Engineering Design Standards.

5. **OBLIGATIONS OF CONTRACTOR.** Contractor is obligated to do the following:

- A. Contractor will provide the materials, equipment, and services as set forth in the Project Manual and Plans.
- B. Contractor will obtain, at Contractor’s sole cost and expense, any applicable permits required by state or local governments as needed for the Work, except for the MN Department of Health permit.
- C. Provide at least 48-hour notice (working days) to ERMU of any water shut-offs. ERMU must review and approve any shutoff prior to notifications.

- D. Coordinate with Hubbard Electric, electrical contractor, and Total Control, systems integrator, chosen by the Owner to complete that work including Division 26.

6. **OBLIGATIONS OF OWNER.** The Owner is obligated to do the following:

- A. Respond to any requests for operation of valve boxes and water shut offs within 48 hours (working days).
- B. ERMU has received from MnDOH a Treatment Plant Renovation Permit.

7. **PAYMENT TO CONTRACTOR.** The Owner will pay Contractor as provided in the Solicitation Package as full and complete payment for the labor, materials, and services rendered pursuant to this Agreement and as described in the Project Manual.

- A. Any changes in the scope of the Work which may result in an increase to the compensation due Contractor shall require prior written approval by an authorized representative of the Owner. The Owner will not pay additional compensation for services that do not have prior written authorization.
- B. If Contractor is delayed in performance due to any cause beyond its reasonable control, including but not limited to strikes, riots, fires, acts of God, governmental actions, actions of a third party, or actions or inactions of the Owner, the time for performance shall be extended by a period of time lost by reason of the delay. Contractor will be entitled to payment for its reasonable additional charges, if any, due to the delay.

8. **METHOD OF PAYMENT.**

- A. Contractor shall prepare and submit to the Owner, on a monthly basis, itemized invoices setting forth work performed under this Agreement. Payment of invoices shall be as follows: 95% of progress pay request amount shall be paid within thirty (30) days following receipt of the payment request. Remaining 5% shall be held as retainage and paid thirty (30) days after final acceptance of the project.
- B. Claims. To receive any payment on this Agreement, the invoice or bill must include the following signed and dated statement: "I declare under penalty of perjury that this account, claim, or demand is just and correct and that no part of it has been paid."
- C. No fuel surcharges or surcharges of any kind will be accepted, nor will they be paid.

9. **STANDARD OF CARE.** Contractor shall exercise the same degree of care, skill and diligence in the performance of its services as is ordinarily exercised by members of the profession under similar circumstances in the City of Elk River, Minnesota. Contractor shall be liable to the fullest extent permitted under applicable law, without limitation, for any injuries, loss, or damages proximately caused by Contractor's breach of this standard of care. Contractor shall put forth reasonable efforts to complete its duties in a timely manner. Contractor shall not be responsible for delays caused by factors beyond its control or that could not be reasonably foreseen at the time of execution of this Agreement. Contractor shall be responsible for costs, delays, or damages arising from unreasonable delays in the performance of its duties.

10. **COMPLIANCE WITH LAWS AND REGULATIONS.** Contractor shall comply with all statutes, ordinances, rules, and regulations applicable to the performance of the Work, and shall cause any subcontractor to do the same.

11. **CONTRACTOR'S INSURANCE.** Contractor shall procure and maintain insurance as outlined below.

- A. All policies shall provide for 30 days' written notice prior to any cancellation or non-renewal of insurance policies required under this Agreement. "Will endeavor" and "but failure to mail such notice shall impose no obligation or liability of any kind upon the Company, its

agents, or representatives” wording shall be deleted from all Certificates of Insurance. All policies shall include a waiver of subrogation in favor of the Owner.

- B. Contractor shall procure and maintain insurance coverage equal to or exceeding the following limits:

Commercial General Liability	\$1,000,000 per occurrence, \$2,000,000 general aggregate
Auto (owned, hired, and non-owned)	\$1,000,000
Workers Compensation/Employers' Liability	In accordance with the laws of the State of Minnesota
Public Liability (for injuries, including accidental death	\$1,000,000 per person
Property Damage Liability	\$1,000,000 per occurrence

Such insurance will name the Owner, its officials, employees, agents, and any successors, heirs or assigns of the Owner, as an additional insured (with respect to the commercial general liability insurance), will be primary and non-contributory with any insurance or self-insurance of the Owner, or any successors, heirs or assigns of the Owner, and include a waiver of subrogation in favor of the Owner. Contractor shall submit to the Owner, in duplicate, Certificates of Insurance prior to commencing any of the Work. Contractor shall require any subcontractor to procure and maintain the same insurance coverage as Contractor. If requested by the Owner, Contractor shall require any subcontractor to provide Certificates of Insurance to the Owner prior to commencing any of the Work.

12. **INDEMNIFICATION.** To the fullest extent permitted by law, Contractor will defend and indemnify the Owner, its officials, employees, agents, and contractors, and hold them harmless from and against all judgments, claims, damages, costs, and expenses, including a reasonable amount as and for its attorney’s fees paid, incurred or for which it may be liable resulting from any breach of this Agreement by Contractor, its officers, employees, agents, and contractors, or any negligent or intentional act or omission performed, taken or not performed or taken by Contractor, its officers, employees, agents, and contractors, relative to this Agreement.

13. **PROTECTION OF WORK AND PROPERTY.** For purposes of this Section 10, the term “Contractor” includes Contractor and its officers, employees, agents, and contractors

- A. Contractor shall continuously maintain adequate protection for all Contractor work from damage and shall protect the Owner’s property from injury or loss arising in connection with this Agreement and shall make good any damage, injury, or loss. Contractor shall adequately protect adjacent property as provided by the law and the Agreement documents. Contractor shall provide and maintain all passageways, guard authority, local conditions, or as the Owner may direct.
- B. If Contractor shall in any manner obstruct a street or highway, Contractor shall put up and maintain barriers and lights to prevent accidents and shall be liable for damages caused by failure to do so. Contractor shall further be liable for all damages caused by the negligent dismantling, assembly, or handling of equipment or which may result from Contractor’s carelessness in the performance of Contractor’s work including water discharged from this construction activity. Contractor shall also be bound by any further requirements of this Agreement or the Solicitation Package on this point.
- C. In an emergency affecting the safety of life or of the Work or adjoining property, Contractor’s project manager, without special instructions from the Owner, is hereby permitted to act at Contractor’s discretion to prevent such threatened loss or injury and Contractor shall so act without appeal, if so instructed and authorized. Any compensation by Contractor on account of emergency work shall be determined by separate agreement.

14. **EXAMINATION OF PROJECT SITE AND DOCUMENTS.** Contractor acknowledges, understands, and agrees to all of the following:

- A. Contractor has satisfied itself regarding the site conditions where the Work will be performed, as well as to all local conditions affecting the performance of this Agreement. Contractor, in submitting a proposal and in executing this Agreement, is deemed to accept such conditions as the same are eventually found to exist and is deemed to waive all claims for extra compensation arising from the encountering of unforeseen difficulties, except as the same are expressly provided for in either this Agreement or the Solicitation Package.
- B. Contractor has carefully read the Solicitation Package before submitting a bid on the Work, and has had the opportunity to have any unclear point fully explained and clarified by the Owner. Professions of ignorance regarding the requirements of the Work will in no way serve to modify the provisions of this Agreement or the Solicitation Package.
- C. All information given on any drawings included in the Solicitation or incorporated into this Agreement relating to existing subsurface and surface conditions and other structures is from the best sources at present available to the Owner. All such information was furnished only for the information and convenience of the Contractor or other bidders.
- D. The Owner does not warrant or guarantee that the existing conditions or other structures encountered during the Work on the Project will be the same as those indicated on any drawings included in the Solicitation or incorporated into this Agreement. Contractor has satisfied itself regarding the character, quantities, and conditions of the various materials and the Work.
- E. Contractor will not use any of the information made available to Contractor or obtained in any examination made by Contractor in any manner as a basis or ground of claim or demand of any nature against the Owner arising from or by reason of any variance which may exist between the information offered and the actual conditions, materials, or structures encountered during the Work, except as may otherwise be provided for in this Agreement or the Solicitation Package.
- F. Contractor assumes the risk that subsurface or latent conditions will vary materially from those shown or otherwise indicated in the Solicitation Package, and took this risk into account in the preparation of Contractor's bid.

15. **SITE MAINTENANCE.** Contractor shall at all times prevent the accumulation of debris caused by the Work on the Project site. Upon completion of the Work, Contractor shall remove from the Work site all such debris, and also Contractor's tools, equipment, and surplus materials. Contractor shall leave the Work site in good order and condition. If Contractor fails to perform these maintenance obligations, the Owner may remove the debris, tools, equipment, or surplus materials, and charge all removal costs to Contractor. Contractor shall require any subcontractors to perform these same obligations, including paying the cost of any removal by the Owner resulting from a failure by any subcontractor.

16. **GENERAL PROVISIONS.**

- A. **NOTICES.** Any notice that is required to be sent by the parties will be in writing and will be treated as fully given when deposited in the United States Mail via prepaid certified mail, return receipt requested, or by prepaid overnight delivery service providing written evidence of delivery, and addressed as follows:

If to the Owner:

ELK RIVER MUNICIPAL UTILITIES

13069 Orono Parkway NW
Elk River, Minnesota 55330
ATTN: General Manager

If to Contractor:

NAME

ADDRESS

CITY/STATE/ZIP

ATTN: NAME

- B. **NONDISCRIMINATION.** Contractor shall comply with all applicable provisions of all federal, state and municipal laws which prohibit discrimination in employment to members of a protected class, and with all rules and regulations, promulgated and adopted pursuant thereto. Contractor shall include a similar provision in all subcontracts entered into for the performance of the Work.
- C. **ASSIGNMENT.** Neither party shall assign this Agreement, nor any interest in or related to this Agreement, without the written consent of the other party.
- D. **WAIVER.** Any waiver by either party of a breach of any provisions of this Agreement shall not affect, in any respect, the validity of the remainder of this Agreement.
- E. **ENTIRE AGREEMENT.** This Agreement represents the entire agreement of the parties. This Agreement supersedes all oral agreements and negotiations between the parties relating to the subject matter of this Agreement, as well as any previous agreements presently in effect between the parties relating to the same. Any alterations, amendments, deletions, or waivers of the provisions of this Agreement shall be valid only when expressed in writing and duly signed by the parties, unless otherwise provided by this Agreement.
- F. **SEVERABILITY.** If any provision or term of this Agreement for any reason is declared invalid, illegal, or unenforceable, such decision will not affect the validity of any remaining provisions, provided that: (i) each party receives the substantial benefit of its bargain with respect to the transaction completed by this Agreement; and (ii) the ineffectiveness of such provision would not result in such a material change as to cause completion of the transactions contemplated by this Agreement to be unreasonable for either party. The remaining provisions will remain in full force and effect as if this Agreement had been executed with the invalid portion thereof eliminated and the parties declare that it is their intention that they would have executed the remaining portions of this Agreement without including any such part or portion which may be hereafter declared invalid.
- G. **CONTROLLING LAW; VENUE.** This Agreement shall be governed by and construed in accordance with the laws of the State of Minnesota. Any dispute arising out of this Agreement shall be venued in the State District Court for Sherburne County, Minnesota.
- H. **MINNESOTA GOVERNMENT DATA PRACTICES ACT.** Contractor must comply with the Minnesota Government Data Practices Act, Minnesota Statutes, Chapter 13, as it applies to (1) all data provided by the Owner pursuant to this Agreement, and (2) all government data, created, collected, received, stored, used, maintained, or disseminated by Contractor pursuant to this Agreement. In performing the Work, Contractor is subject to all the provisions of the Minnesota Government Data Practices Act, including but not limited to the civil remedies of Minnesota Statutes Section 13.08, as if it were a government entity. In the event Contractor receives a request to release data, Contractor must immediately notify the Owner. The Owner will give Contractor instructions concerning the release of the data to the requesting party before the data is released. Contractor agrees to defend, indemnify, and hold Owner, its

officials, employees, contractors, and agents harmless from any claims resulting from unlawful disclosure and/or use of protected data by Contractor, its officers, employees, agents or subcontractors. The terms of this Section 16.G shall survive the cancellation or termination of this Agreement.

IN WITNESS WHEREOF, the Owner and Contractor have executed this Agreement to be effective as of the day and year first written above.

ELK RIVER MUNICIPAL UTILITIES

By: _____
Mark Hanson, General Manager

CONTRACTOR

By: _____
NAME, TITLE

**Treatment Plant 7 Modifications
Bid Form**

**Elk River Municipal Utilities
Elk River, Minnesota**

To Elk River Municipal Utilities

Date _____

Pursuant to the request inviting quotes for the Treatment Plant 7 Modifications as described in the specifications and plans excluding any electrical and control work (the "Project") for the Elk River Municipal Utilities in Elk River, Minnesota, the undersigned contractor, being familiar with all conditions affecting the cost of the work and materials, does hereby agree to furnish the required material and do all work required to complete the construction for which this proposal is submitted, in accordance with plans and specifications on file with Elk River Municipal Utilities; and agrees to be bound, upon the acceptance of this proposal, to execute an agreement, of which this proposal, the said advertisement, agreement, information for contractors, plans and specifications shall be part of the performance and completion of said work within the time required in the agreement, and at a price named in the schedules which follow, which are made part of this proposal.

We propose to do this work for the following listed prices:

BID ITEM	QUANTITY	UNIT DESCRIPTION	PRICE	TOTAL
1.	1	Treatment Plant 7 Modifications	Lump Sum	\$_____

TOTAL BID: \$_____

Contractor agrees to guarantee all work performed under the Agreement and to renew or repair any work which may be rejected due to defective material or work quality, within two (2) years after completion and acceptance of the Project by Elk River Municipal Utilities.

Dated _____

Firm _____

Address _____

By _____

Title _____

Phone Number _____

Fax Number _____

Federal Employer Id Number _____

I, _____, Notary Public in and for the above named County and State do hereby certify that _____ personally known to me to be the affiant in the foregoing affidavit, personally appeared before me this day, and, having been duly sworn, deposes and say that the facts set forth in the above affidavit are true and correct.

WITNESS my hand and seal this _____ day of _____, 2026.

Notary Public

PRIME CONTRACTOR RESPONSE

RESPONSIBLE CONTRACTOR VERIFICATION AND CERTIFICATION OF COMPLIANCE

PROJECT NUMBER: 192017

This form includes changes by statutory references from the Laws of Minnesota 2015, chapter 64, sections 1-9. This form must be submitted with the response to this solicitation. A response received without this form, will be rejected.

Minn. Stat. § 16C.285, Subd. 7. **IMPLEMENTATION.** ... any prime contractor or subcontractor or motor carrier that does not meet the minimum criteria in subdivision 3 or fails to verify that it meets those criteria is not a responsible contractor and is not eligible to be awarded a construction contract for the project or to perform work on the project...

Minn. Stat. § 16C.285, Subd. 3. **RESPONSIBLE CONTRACTOR, MINIMUM CRITERIA.** "Responsible contractor" means a contractor that conforms to the responsibility requirements in the solicitation document for its portion of the work on the project and verifies that it meets the following minimum criteria:

- | | |
|-----|--|
| (1) | <p>The Contractor:</p> <ul style="list-style-type: none">(i) is in compliance with workers' compensation and unemployment insurance requirements;(ii) is in compliance with Department of Revenue and Department of Employment and Economic Development registration requirements if it has employees;(iii) has a valid federal tax identification number or a valid Social Security number if an individual; and(iv) has filed a certificate of authority to transact business in Minnesota with the Secretary of State if a foreign corporation or cooperative. |
| (2) | <p>The contractor or related entity is in compliance with and, during the three-year period before submitting the verification, has not violated section 177.24, 177.25, 177.41 to 177.44, 181.13, 181.14, or 181.722, and has not violated United States Code, title 29, sections 201 to 219, or United States Code, title 40, sections 3141 to 3148. For purposes of this clause, a violation occurs when a contractor or related entity:</p> <ul style="list-style-type: none">(i) repeatedly fails to pay statutorily required wages or penalties on one or more separate projects for a total underpayment of \$25,000 or more within the three-year period, provided that a failure to pay is "repeated" only if it involves two or more separate and distinct occurrences of underpayment during the three-year period;(ii) has been issued an order to comply by the commissioner of Labor and Industry that has become final;(iii) has been issued at least two determination letters within the three-year period by the Department of Transportation finding an underpayment by the contractor or related entity to its own employees;(iv) has been found by the commissioner of Labor and Industry to have repeatedly or willfully violated any of the sections referenced in this clause pursuant to section 177.27;(v) has been issued a ruling or findings of underpayment by the administrator of the Wage and Hour Division of the United States Department of Labor that have become final or have been upheld by an administrative law judge or the Administrative Review Board; or(vi) has been found liable for underpayment of wages or penalties or misrepresenting a construction worker as an independent contractor in an action brought in a court having jurisdiction. Provided that, if the contractor or related entity contests a determination of underpayment by the Department of Transportation in a contested case proceeding, a violation does not occur until the contested case proceeding has concluded with a determination that the contractor or related entity underpaid wages or penalties;* |

(3)	The contractor or related entity is in compliance with and, during the three-year period before submitting the verification, has not violated section 181.723 or chapter 326B. For purposes of this clause, a violation occurs when a contractor or related entity has been issued a final administrative or licensing order;*
(4)	The contractor or related entity has not, more than twice during the three-year period before submitting the verification, had a certificate of compliance under section 363A.36 revoked or suspended based on the provisions of section 363A.36, with the revocation or suspension becoming final because it was upheld by the Office of Administrative Hearings or was not appealed to the office;*
(5)	The contractor or related entity has not received a final determination assessing a monetary sanction from the Department of Administration or Transportation for failure to meet targeted group business, disadvantaged business enterprise, or veteran-owned business goals, due to a lack of good faith effort, more than once during the three-year period before submitting the verification;*
	* Any violations, suspensions, revocations, or sanctions, as defined in clauses (2) to (5), occurring prior to July 1, 2014, shall not be considered in determining whether a contractor or related entity meets the minimum criteria.
(6)	The contractor or related entity is not currently suspended or debarred by the federal government or the state of Minnesota or any of its departments, commissions, agencies, or political subdivisions that have authority to debar a contractor; and
(7)	All subcontractors and motor carriers that the contractor intends to use to perform project work have verified to the contractor through a signed statement under oath by an owner or officer that they meet the minimum criteria listed in clauses (1) to (6).

Minn. Stat. § 16C.285, Subd. 5. **SUBCONTRACTOR VERIFICATION.**

A prime contractor or subcontractor shall include in its verification of compliance under subdivision 4 a list of all of its first-tier subcontractors that it intends to retain for work on the project. Prior to execution of a construction contract, and as a condition precedent to the execution of a construction contract, the apparent successful prime contractor shall submit to the contracting authority a supplemental verification under oath confirming compliance with subdivision 3, clause (7). Each contractor or subcontractor shall obtain from all subcontractors with which it will have a direct contractual relationship a signed statement under oath by an owner or officer verifying that they meet all of the minimum criteria in subdivision 3 prior to execution of a construction contract with each subcontractor.

If a prime contractor or any subcontractor retains additional subcontractors on the project after submitting its verification of compliance, the prime contractor or subcontractor shall obtain verifications of compliance from each additional subcontractor with which it has a direct contractual relationship and shall submit a supplemental verification confirming compliance with subdivision 3, clause (7), within 14 days of retaining the additional subcontractors.

A prime contractor shall submit to the contracting authority upon request copies of the signed verifications of compliance from all subcontractors of any tier pursuant to subdivision 3, clause (7). A prime contractor and subcontractors shall not be responsible for the false statements of any subcontractor with which they do not have a direct contractual relationship. A prime contractor and subcontractors shall be responsible for false statements by their first-tier subcontractors with which they have a direct contractual relationship only if they accept the verification of compliance with actual knowledge that it contains a false statement.

Subd. 5a. Motor carrier verification. A prime contractor or subcontractor shall obtain annually from all motor carriers with which it will have a direct contractual relationship a signed statement under oath by an owner or officer verifying that they meet all of the minimum criteria in subdivision 3 prior to execution of a construction contract with each motor carrier. A prime contractor or subcontractor shall require each such motor carrier to provide it with immediate written notification in the event that the motor carrier no longer meets one or more of the minimum criteria in subdivision 3 after submitting its annual verification. A motor carrier shall be ineligible to perform work on a project covered by this section if it does not meet all the minimum criteria in subdivision 3. Upon request, a prime contractor or subcontractor shall submit to the contracting authority the signed verifications of compliance from all motor carriers providing for-hire transportation of materials, equipment, or supplies for a project.

Minn. Stat. § 16C.285, Subd. 4. **VERIFICATION OF COMPLIANCE.**

A contractor responding to a solicitation document of a contracting authority shall submit to the contracting authority a signed statement under oath by an owner or officer verifying compliance with each of the minimum criteria in subdivision 3, with the exception of clause (7), at the time that it responds to the solicitation document.

A contracting authority may accept a signed statement under oath as sufficient to demonstrate that a contractor is a responsible contractor and shall not be held liable for awarding a contract in reasonable reliance on that statement. A prime contractor, subcontractor, or motor carrier that fails to verify compliance with any one of the required minimum criteria or makes a false statement under oath in a verification of compliance shall be ineligible to be awarded a construction contract on the project for which the verification was submitted.

A false statement under oath verifying compliance with any of the minimum criteria may result in termination of a construction contract that has already been awarded to a prime contractor or subcontractor or motor carrier that submits a false statement. A contracting authority shall not be liable for declining to award a contract or terminating a contract based on a reasonable determination that the contractor failed to verify compliance with the minimum criteria or falsely stated that it meets the minimum criteria. A verification of compliance need not be notarized. An electronic verification of compliance made and submitted as part of an electronic bid shall be an acceptable verification of compliance under this section provided that it contains an electronic signature as defined in section 325L.02, paragraph (h).

CERTIFICATION

By signing this document I certify that I am an owner or officer of the company, and I swear under oath that:

- 1) My company meets each of the Minimum Criteria to be a responsible contractor as defined herein and is in compliance with Minn. Stat. § 16C.285, and**
- 2) if my company is awarded a contract, I will submit Attachment A-1 prior to contract execution, and**
- 3) if my company is awarded a contract, I will also submit Attachment A-2 as required.**

Authorized Signature of Owner or Officer:

Printed Name:

Title:

Date:

Company Name:

NOTE: Minn. Stat. § 16C.285, Subd. 2, (c) If only one prime contractor responds to a solicitation document, a contracting authority may award a construction contract to the responding prime contractor even if the minimum criteria in subdivision 3 are not met.

ATTACHMENT A-1

FIRST-TIER SUBCONTRACTORS LIST

SUBMIT PRIOR TO EXECUTION OF A CONSTRUCTION CONTRACT

PROJECT NUMBER: 192017

Minn. Stat. § 16C.285, Subd. 5. A prime contractor or subcontractor shall include in its verification of compliance under subdivision 4 a list of all of its first-tier subcontractors that it intends to retain for work on the project. Prior to execution of a construction contract, and as a condition precedent to the execution of a construction contract, the apparent successful prime contractor shall submit to the contracting authority a supplemental verification under oath confirming compliance with subdivision 3, clause (7). Each contractor or subcontractor shall obtain from all subcontractors with which it will have a direct contractual relationship a signed statement under oath by an owner or officer verifying that they meet all of the minimum criteria in subdivision 3 prior to execution of a construction contract with each subcontractor.

FIRST TIER SUBCONTRACTOR NAMES* (Legal name of company as registered with the Secretary of State)	Name of city where company home office is located

*Attach additional sheets as needed for submission of all first-tier subcontractors.

SUPPLEMENTAL CERTIFICATION FOR ATTACHMENT A-1	
By signing this document I certify that I am an owner or officer of the company, and I swear under oath that: All first-tier subcontractors listed on attachment A-1 have verified through a signed statement under oath by an owner or officer that they meet the minimum criteria to be a responsible contractor as defined in Minn. Stat. § 16C.285.	
Authorized Signature of Owner or Officer:	Printed Name:
Title:	Date:
Company Name:	

ATTACHMENT A-2

ADDITIONAL SUBCONTRACTORS LIST

PRIME CONTRACTOR TO SUBMIT AS SUBCONTRACTORS ARE ADDED TO THE PROJECT

PROJECT NUMBER: 192017

This form must be submitted to the Project Manager or individual as identified in the solicitation document.

Minn. Stat. § 16C.285, Subd. 5. ... If a prime contractor or any subcontractor retains additional subcontractors on the project after submitting its verification of compliance, the prime contractor or subcontractor shall obtain verifications of compliance from each additional subcontractor with which it has a direct contractual relationship and shall submit a supplemental verification confirming compliance with subdivision 3, clause (7), within 14 days of retaining the additional subcontractors. ...

ADDITIONAL SUBCONTRACTOR NAMES* (Legal name of company as registered with the Secretary of State)	Name of city where company home office is located

*Attach additional sheets as needed for submission of all additional subcontractors.

SUPPLEMENTAL CERTIFICATION FOR ATTACHMENT A-2	
By signing this document I certify that I am an owner or officer of the company, and I swear under oath that: All additional subcontractors listed on Attachment A-2 have verified through a signed statement under oath by an owner or officer that they meet the minimum criteria to be a responsible contractor as defined in Minn. Stat. § 16C.285.	
Authorized Signature of Owner or Officer:	Printed Name:
Title:	Date:
Company Name:	

PERFORMANCE BOND

KNOW ALL PERSONS BY THESE PRESENTS: That

(Name of Contractor)

(Address of Contractor)

a _____, hereinafter called Principal, and
(corporation, partnership, or individual)

(Name of Surety)

(Address of Surety)

hereinafter called Surety, are held and firmly bound unto _____
The Elk River Municipal Utilities
(Name of Owner)

13069 Orono Parkway, Elk River, MN 55330
(Address of Owner)

hereinafter called **OWNER**, in the total aggregate sum of:

_____ (**\$xxx,xxx.xx**) in lawful money of the
United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs,
executors, administrators, successors, and assign, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain contract with the Owner, dated the _____ day of _____, 2026, a copy of which is hereto attached and made a part hereof for the construction of: Treatment Plant 7 Modifications.

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms, conditions, and agreements of a said contract during the original term thereof, and any extensions thereof which may be granted by the **OWNER** with or without notice to the Surety and during the one year guaranty period, and if he shall satisfy all claims and demands incurred under such contract, and shall fully indemnify and save harmless the **OWNER** from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the **OWNER** all outlay and expense which the **OWNER** may incur in making good and default, then this obligation shall be void, otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said Surety for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or to work to be performed thereunder or the Specifications accompanying the same shall in any way affect its obligations on this Bond, and it does hereby waive notice of any such change, extension of the time, alteration, or addition to the terms of the contract or to the work or to the Specification.

PROVIDED, FURTHER, that it is expressly agreed that the Bond shall be deemed amended automatically and immediately, without formal and separate amendments hereto, upon amendment to the Contract not increasing the contract price more than 20 percent, so as to bind the Principal and Surety to the full and faithful performance of the Contract as so amended. The term "Amendment", wherever used in this Bond, and whether referring to this Bond, the Contract or the Loan Documents shall include any alteration, addition, extension, or modification of any character whatsoever.

PROVIDED, FURTHER, that no final settlement between the Owner and the Principal shall abridge the right of the other beneficiary hereunder whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in three counterparts, each one, of which shall be deemed an original, this the _____ day of _____, 2026.

ATTEST:

(Principal) Secretary

Principal

(SEAL)

By: _____(s)

Witness to Principal

Address

(Address)

Surety

ATTEST:

Witness to Surety

By _____
Attorney-In-Fact

Address

By _____
Address

By _____

Note: Date of Bond must not be prior to date of Contract. If Contractor is partnership, all partners should execute Bond.

Important: Surety companies executing Bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the project is located.

PAYMENT BOND

KNOW ALL PERSONS BY THESE PRESENTS: That

(Name of Contractor)

(Address of Contractor)

a _____, hereinafter called Principal, and
(corporation, partnership, or individual)

(Name of Surety)

hereinafter called Surety, are held and firmly bound unto _____
The Elk River Municipal Utilities
(Name of Owner)

13069 Orono Parkway, Elk River, MN 55330
(Address of Owner)

hereinafter called Owner, and unto all persons, firms and corporations who or which may furnish labor, or who furnish materials to perform as described under the contract and to their successors and assigns in the total aggregate penal sum of _____ (\$xxx,xxx.xx) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assign, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain contract with the Owner, dated the _____ day of _____, 2026 a copy of which is hereto attached and made a part hereof for the construction of: Treatment Plant 7 Modifications.

NOW, THEREFORE, if the Principal shall promptly make payment to all persons, firms, and corporations furnishing materials for or performing labor in the prosecution of the work provided for in such contract, and any authorized extensions or modification thereof, including all amounts due for materials, lubricants, oil, gasoline, coal and coke, repairs on machinery, equipment and tools, consumed or used in connection with the construction of such work, and for all labor cost incurred in such work including that by a subcontractor, and to any mechanic or materialman lienholder whether it acquires its lien by operation of State or Federal law; then this obligation shall be void, otherwise to remain in full force and effect.

PROVIDED, that beneficiaries or claimants hereunder shall be limited to the subcontractors, and persons, firms and corporations having a direct contract with the principal or its subcontractors.

PROVIDED, FURTHER, that the said Surety for value received stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or to work to be performed thereunder or the Specifications accompanying the same shall in any way affect its obligations on this Bond, and it does hereby waive notice of any such change, extension of the time, alteration, or addition to the terms of the contract or to the work or to the Specification.

PROVIDED, FURTHER, that no suit or action shall be commenced hereunder by any claimant: (a) Unless the claimant, other than one having a direct contract with the Principal, shall have given written notice to any two of the following: the Principal, the Owner, or the Surety above named within ninety (90) days after such claimant did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the work or labor was done or performed. Such notice

shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the Principal, Owner, or Surety, at any place where an office is regularly maintained for the transaction of business, or served in any manner in which legal process may be served in the state in which the aforesaid project is located, save that such service need not be made by a public officer. (b) After the expiration of one (1) year following the date of which Principal ceased work on said Contract, it being understood, however, that if any limitation embodied in the Bond is prohibited by any law controlling the construction hereof, such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

PROVIDED, FURTHER, that it is expressly agreed that the Bond shall be deemed amended automatically and immediately, without formal and separate amendments hereto, upon amendment to the Contract not increasing the contract price more than 20 percent, so as to bind the Principal and Surety to the full and faithful performance of the Contract as so amended. The term "Amendment", wherever used in this Bond, and whether referring to this Bond, the Contract or the Loan Documents shall include any alteration, addition, extension, or modification of any character whatsoever.

PROVIDED, FURTHER, that no final settlement between the Owner and the Principal shall abridge the right of the other beneficiary hereunder whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in three counterparts, each one, of which shall be deemed an original, this the _____ day of _____, 2026.

ATTEST:

(Principal) Secretary

Principal

(SEAL)
By: _____(s)

Witness to Principal

Address

(Address)

Surety

ATTEST:

Witness to Surety

By _____
Attorney-In-Fact

Address

Address

Note: Date of Bond must not be prior to date of Contract. If Contractor is partnership, all partners should execute Bond.

Important: Surety companies executing Bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the project is located.

STATE OF MINNESOTA)
COUNTY OF SHERBURNE)

_____ of _____
(Officer's Name and Title) (Contractor's Name)

_____ states further that Contractor has full knowledge of all
(Officer's Name)

Contractor will hold the Owners, the Elk River Municipal Utilities, blameless of any and all Mechanic's Liens that may be hereafter entered or filed for record, so as to constitute charge against said premises for work or labor done or materials furnished by them.

SEAL _____
(Officer's Name)

WITNESS my hand and seal this _____ day of _____, 2026.

230649v1

This Page Left Blank Intentionally

CERTIFICATION

I hereby certify that this specification was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.



Andrew Knapp, PE

Date: August 14, 2026 License. No. 62882

END OF SECTION

This Page Left Blank Intentionally

TABLE OF CONTENTS

Number	Document
	Introductory Information
00 01 05	Certification
00 01 10	Table of Contents
DIVISION 2 - EXISTING CONDITIONS	
	Demolition and Structure Moving
02 41 19	Selective Demolition
DIVISION 9 - FINISHES	
	Painting and Coating
09 97 21	Coating Systems for Water Treatment Facilities
DIVISION 26 – ELECTRICAL	
26 00 00	General Provisions for Electrical Systems
26 05 01	Electrical Demolition
26 05 19	Low-Voltage Electrical Power Conductors and Cables
26 05 23	Control-Voltage Electrical Power Cables
26 05 29	Hangers and Supports for Electrical Systems
26 05 33	Raceways and Boxes for Electrical Systems
26 05 44	Sleeves and Sleeve Seals for Electrical Raceways and Cabling
DIVISION 40 - PROCESS INTEGRATION	
40 05 57.23	Electric Actuators
40 23 00	Process Piping General Provisions
40 23 10	Process Water and Waste Piping
40 23 20	Process Piping Valves
40 23 30	Process Piping Specialties
40 23 40	Process Piping Hangers and Supports
40 23 50	Process Piping Testing, Adjusting, and Disinfection
40 90 00	Control Systems
40 91 19	Instrumentation
DIVISION 43 - PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE EQUIPMENT	
43 22 52	Magnetic Flowmeters
DIVISION 46 - WATER AND WASTEWATER EQUIPMENT	
46 31 11	Gas Chlorine Feed Equipment

This Page Left Blank Intentionally

SELECTIVE DEMOLITION

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Removal of abandoned utilities and wiring systems.
 - 2. Salvaging and disposal of removed items.

1.02 REFERENCES

- A. Industry Standard - "Safety Requirements for Demolition Operations American National Standard for Construction and Demolition Operations," ASSE A10.6

1.03 SUBMITTALS

- A. Qualification Data: For demolition firm.
- B. Schedule of demolition activities, indicating:
 - 1. Detailed sequence of selective demolition and removal Work, with starting and ending dates for each activity.
 - 2. Interruption of utility services.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Locations of proposed dust and noise control temporary partitions and means of egress.
 - 5. Coordination of Owner's continuing occupancy of portions of existing building.
 - 6. Means of protection for items to remain and items in path of waste removal from building.
- C. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- D. Predemolition Photographs or Videotapes: Show existing condition of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damaged caused by selective demolition operations.

1.04 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Be familiar with and comply with all pertinent federal, state and local regulations for demolition and disposal.
- C. Obtain and File Required Documentation:
 - 1. EPA.
 - 2. MPCA.
 - 3. MN Department of Health.
 - 4. Local or County Solid Waste Management.
 - 5. Landfill.
- D. Predemolition Conference: Conduct conference at Site with Engineer to review methods and procedures related to selective demolition.

1.05 PROJECT/SITE CONDITIONS

- A. Existing Piping or Utilities:
 - 1. Determine requirements for disconnecting, capping and protection with Owner.
 - 2. Repair damaged utilities or piping at no cost to Owner.
- B. Uncharted or Incorrectly Charted Existing Piping or Utilities:
 - 1. Consult utility and Owner immediately for directions.
 - 2. Cooperate with Owner and utility companies to keep services and facilities in operation.
 - 3. Repair damaged utilities to satisfaction of utility and Owner.
- C. Hazardous Materials:
 - 1. It is not expected that hazardous materials will be encountered in the Work. If encountered, do not disturb. Immediately notify Engineer and Owner.
- D. Site Access: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

PART 2 PRODUCTS

2.01 MATERIALS FOR PROTECTION

- A. Materials not specifically described but required for complete and proper protection shall be selected by Contractor, subject to acceptance of Engineer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions:
 - 1. Before beginning Work, visit site to verify existing conditions.
 - 2. Verify that demolition and alterations may be performed in accordance with design, pertinent codes and regulations.
 - 3. Bring questions regarding alterations to attention of Engineer.
 - 4. Coordinate work with Engineer to minimize inconvenience to Owner and occupants of building, if any.
- B. Discrepancies: Immediately notify Engineer. Do not proceed with Work in areas of discrepancy until fully resolved.

3.02 NOTIFICATION AND DOCUMENTATION

- A. Prior to commencing Work, obtain, complete, and file required permits and forms.
- B. Notify Owner of schedule for shut-off of utilities serving occupied spaces.
- C. Verify that utilities have been disconnected and capped.
- D. Notify the appropriate authorities, in the required time, prior to demolition and disposal:
 - 1. EPA.
 - 2. MPCA.
 - 3. MN Department of Health.
 - 4. Local or County Solid Waste Management.
 - 5. Landfill.

3.03 PREPARATION

- A. Erect barricades and other protective devices as required to protect:
 - 1. Existing construction designated to remain.
 - 2. Installed work and materials of other trades.
 - 3. Materials and finishes on areas adjacent to demolition Work.
 - 4. Workers, passersby, occupants of adjoining space and/or adjacent property.
 - 5. Access and egress from existing building. Ensure that functionally and legally required exits and exitways remain free, unobstructed during entire course of Project.
- B. Shoring, Bracing, Support:
 - 1. Provide interior and exterior devices to support portions of building and prevent movement, settlement, collapse of structures to be demolished and adjacent facilities.
 - 2. Strengthen or add new supports when required during progress of selective demolition.
- C. Provide temporary weather and fire protection.
- D. Dust Control:
 - 1. Moisten areas and items that will not be damaged by water.
 - 2. Provide dust barriers between areas of demolition and occupied spaces.

3.04 DEMOLITION

- A. Carefully, neatly remove construction, materials, ceilings, finishes, as indicated on Drawings, as specified, or as required by construction.
- B. Neatly cut new openings in existing walls, floors, partitions, ceilings, and roof, as required.
- C. Cut back portions of walls or partitions where cross walls are removed to allow proper repair of walls without abrupt changes in plane.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Engineer.
- E. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

3.05 DISPOSAL OF MATERIALS

- A. Salvaged Materials(See Drawings for materials to be reused or relocated):
 - 1. Carefully salvage designated items for reuse and properly store at location provided by Owner.
 - 2. Remove from Site salvaged material not designated to be reused.
 - 3. Items to be turned over to Owner: Properly store at location provided by Owner.
- B. Recyclable Materials:
 - 1. Recycle as many materials as reasonably possible.
- C. Debris:
 - 1. Remove from building as Work progresses.
 - 2. Maintain premises in neat, clean condition.
 - 3. Remove from Site weekly (minimum).
 - 4. Legally transport and dispose of rubble, refuse, or waste generated by Work at "permitted" location off Site in safe manner.
 - 5. Burning of combustible materials not permitted on Site.

- D. Hazardous Materials: Comply with applicable regulations, laws and ordinances concerning removal, handling and protection against exposure or environmental pollution for items including, but not limited to:
 - 1. Non-friable asbestos such as vinyl asbestos floor tile.
 - 2. Fluorescent light ballasts unless stamped indicating that ballast is PCB free, or tested to indicate such.
 - 3. CFs in air conditioning units, refrigerators, and other compressors.
 - 4. Lead-based paints.
- E. Provide typed, notarized documentation listing materials disposed, method of disposal, and location of disposal.

3.06 REPAIR/RESTORATION

- A. Immediately repair or replace damages resulting from Work to acceptance of Engineer, at no additional cost to Owner.
- B. Clean alteration Work as specified for similar materials elsewhere in this Project Manual.
- C. "Hyper-vacuum" areas of lead-based paint.
- D. Leave Work in a neat, orderly condition suitable to receive additional construction or finishes or to remain exposed, as indicated on Drawings.

END OF SECTION

COATING SYSTEMS FOR WATER TREATMENT FACILITIES

PART 1 GENERAL

1.01 SUMMARY

- A. Provide surface preparation and application of high-performance industrial coatings.

1.02 SURFACES REQUIRED TO BE PAINTED

- A. All new process piping shall be painted.

1.03 SURFACES NOT REQUIRED TO BE PAINTED

- A. Non-ferrous and corrosion-resistant ferrous alloys, such as copper, bronze, monel, aluminum, chromium plate, stainless steel, factory finished metal roofing, metal facing panels, metal soffits, plus fiberglass, except as noted below. Therefore, paint the following:
 - 1. Where required for electrical insulation between dissimilar metals.
 - 2. Aluminum in contact with concrete or masonry.
 - 3. Vents, grills, and louvers that are not prefinished.
 - 4. Copper water and drainage piping systems, including valves and accessories.
- B. The following surfaces shall not be painted:
 - 1. Factory or installer-finished items.
 - 2. Valves on PVC Piping Systems.

1.04 REFERENCES

- A. ASTM - American Society for Testing Materials
- B. International Concrete Repair Institute (ICRI)
- C. NACE International (NACE)
- D. NSF - ANSI/NSF Standard 61 - Drinking Water System Components
- E. Society for Protective Coatings (SSPC):
 - 1. Volume 1: Good Painting Practice
 - 2. Volume 2: Systems and Specifications

1.05 DEFINITIONS

- A. Applicator: Person applying the product in the field at Site.
- B. Containment: Equipment, supports, screens, tarps, or shrouds that prevent airborne debris generated during surface preparation and coating application from entering the environment, and also facilitates controlled collection of debris for disposal in compliance with current regional and federal regulations.
- C. Dry Film Thickness (DFT): Minimum dry coating thickness.
- D. Immersion Service: Surfaces subject to immersion, or constant exposure to high humidity and condensation.
- E. LEL: Lower Explosion Limit.

- F. Moderate Service: Surfaces subject to normal exposure and moderate humidity. Includes concrete, concrete masonry, structural steel, miscellaneous metals, doors, and frames.
- G. Regional: The state in which the Project is located and surrounding states.
- H. Severe Service: Surfaces subject to frequent splashing, spilling, and exposure to high humidity and condensation. Includes structural steel, miscellaneous metals, piping, valves, and equipment.
- I. SFPG: Square feet per gallon.
- J. VOC: Volatile Organic Compounds.

1.06 SUBMITTALS

- A. Pre-construction Submittals:
 - 1. Information required in Article 1.05 Quality Assurance of this Section.
 - 2. Manufacturers' current Product Data sheets.
 - a. Coatings
 - b. Abrasive(s)
 - c. Additives (as applicable)
 - 3. Provide list of equipment to be used on this Project for review by Engineer.
 - 4. Safety Data Sheets (SDS) for each product specified.
 - 5. Samples:
 - a. Color chips of available colors.
 - b. Recommended colors for color code marking.
 - 6. Written plan for containment of fugitive airborne particles compliant with current state and/or federal regulations.
- B. Post-construction Contract Closeout: Daily application records using Engineer's provided format at the end of this Section.

1.07 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide coating products from a single manufacturer.
- B. Performance Criteria: The surfaces to receive the protective lining shall be capable of withstanding constant exposures within a water treatment facility. Products must have sufficient field history to substantiate product viability for these exposures.
- C. Source Quality Control: Provide each component of protective lining produced by a single manufacturer; including recommended repair mortar, repair overlay (resurfacer), base coat and topcoat materials.
- D. Reference Standards: Comply with applicable provisions and recommendations of all standards listed in Section 1.2 except as otherwise shown or specified
- E. Qualifications:
 - 1. Applicator shall have minimum of 5 years application experience on projects of similar size and scope.
 - 2. Provide written statement from coating manufacturer's authorized representative attesting that Applicator has been instructed on proper preparation, mixing, and application procedures for coating specified.
 - 3. Provide regional references for coating contractor for a minimum of 5 different projects of similar size and scope completed in the last 5 years, including:
 - a. Contact person and phone number.
 - b. Project location.
 - c. Cost of coating work.
 - d. Start/finish dates.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Site in original, factory-sealed containers bearing manufacturer's intact name and legible label with the following information.
 - 1. Material identification by name or number.
 - 2. Manufacturer's stock number, batch number, and date of manufacture.
 - 3. Color name and number.
- B. Storage:
 - 1. Store materials in an environmentally controlled location as recommended by coating manufacturer's product information guidelines.
 - 2. Store materials not in actual use in tightly covered containers.
 - 3. Comply with health and fire regulations of governing authorities having jurisdiction.
- C. Handling:
 - 1. Handle materials in a manner that precludes the possibility of contamination or incorrect product catalyzation.
 - 2. Do not open containers or mix components until surface preparation has been completed and approved by Engineer.
 - 3. Maintain containers used for storage, mixing, and application in a clean condition, free of foreign materials and residue.

1.09 PROJECT CONDITIONS

- A. Site Facilities:
 - 1. As necessary to maintain required ambient conditions and contract scheduling, the contractor shall provide all required equipment for supplemental heating, dehumidification and power.
 - 2. Maintain environmental conditions, including temperature, dew point and humidity within range recommended by coating manufacturer.
 - 3. Do not use heat sources that emit carbon dioxide or carbon monoxide into areas being coated.
 - 4. Properly locate and vent all such heat sources to the exterior such that coating systems are unaffected by exhaust products.
 - 5. Provide lighting to the satisfaction of Engineer to illuminate the complete workspace during blasting, coating, and inspection operations.
- B. Environmental Conditions:
 - 1. Coating shall not be applied in rain, snow, fog, or mist.
 - 2. Conduct surface preparation and coating operations only when the following conditions are met.
 - a. Ambient air temperature is within limits recommended by coating manufacturer.
 - b. Steel surface temperature is more than 5 degrees above the dew point of the ambient air.
 - c. Surfaces to be painted are clean and completely dry.
 - 3. Provide the following through the use of dehumidification equipment:
 - a. Dew point of the ambient air at a minimum 15 degrees below the surface and air temperature.
 - b. Dehumidification shall be maintained at all times during surface preparation, coating application, and cure.
- C. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.10 SEQUENCING AND SCHEDULING

- A. Schedule blasting, cleaning, and painting so that contaminants from cleaning process will not come in contact with wet, newly painted surfaces.
- B. Do not apply coatings until surface preparation has been approved by Engineer.
- C. Do not apply finish coats until:
 - 1. All prime coat application is completed.

2. All surfaces have been cleaned.
 3. All surfaces have been approved for coating by Engineer.
- D. Damage to painted surfaces incurred during construction shall be repainted by the Contractor at no cost to the Owner.
- E. General Contractor shall coordinate with painting subcontractor, paint supplier, and equipment and material suppliers that factory applied coatings are compatible with final coatings of proposed manufacturers of this Section.
- F. Protection: Cover or otherwise protect finished work of other trades and surfaces not being painted concurrently or not to be painted.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Coatings:
1. Acceptable Manufacture: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - a. BASF www.basfbuildingsystems.com
 - b. CIM Industries (CIM) www.cimind.com
 - c. General Polymers Corporation (GPC) www.generalpolymers.com
 - d. Sherwin Williams (SWC) www.sherwin.com
 - e. Tnemec (TCI) www.tnemec.com
- B. Sealant Caulking:
1. Sika-Flex 1A by Sika Corporation www.sikausa.com
 2. BASF Caulks & Sealants
 3. Thiokol Polysulfide Caulk
 4. Or equivalent
- C. Corrosion Inhibitor: HoldTight 102 by HoldTight, Houston, TX www.holdtight.com
- D. Substitution of fast-cure products or acceleration additives must receive prior approval by Engineer.

2.02 MATERIALS

- A. Regulatory Requirements:
1. Products shall comply with the United States Clean Air Act for maximum VOC content.
 2. Products shall comply with state environmental and health standards.
 3. All products shall be lead, chromate, mercury and heavy metals free.
- B. Thinners: Use thinners approved by coating manufacturer and within their recommended limits.
- C. Abrasives:
1. Abrasive materials must be in compliance with state environmental and health standards.
 2. Properly size abrasives to provide the specified surface profile.
 3. The use of abrasives exceeding 1 percent free silica is prohibited.
- D. All unspecified materials, such as shellac, turpentine, or linseed oil, shall be the "best grade" or "first line" product made by a reputable recognized manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for application and notify Engineer in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected.
- B. Notify Engineer in writing of anticipated problems using specified systems with substrates primed by others.
- C. Prepare existing materials or substrates to be coated to meet the requirements of specified coating system.
- D. Starting of painting Work will be construed as Contractor's acceptance of surfaces and conditions within any particular area.

3.02 PREPARATION

- A. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items not to be painted, or provide surface-applied protection prior to surface preparation and painting. Following completion of painting, reinstall removed items.
- B. Clean and remove all rust, slag, weld splatter, weld scabs, mill scale, loose paint, and surface contaminants
- C. Chip or grind off flux, spatter, slag or other laminations left from welding. Grind welds and other sharp projects smooth.
- D. Re-blast all Surfaces:
 - 1. Where rusting has occurred.
 - 2. That do not meet the requirements of this Section.
- E. Feather edges of existing coating to form a smooth transition prior to spot priming.
- F. Scarify previously applied coatings in accordance with coating manufacturer's recommendations.
- G. All substrates: Prepare surface profiles in accordance with manufacturer's recommendations.
- H. Prime all bare metal and touch-up damaged shop-applied prime coat with specified primer. Prepare and coat in accordance with this Section.
- I. Mix corrosion inhibitor and apply in accordance with manufacturer's recommendations.
- J. Fill cracks and voids according to coating manufacturer's recommendations.
- K. Surface Preparation Classifications:
 - 1. P1: SSPC-SP1 - Solvent Cleaning.
 - a. Scarify surface by sanding.
 - b. Brush blast if recommended by coating manufacturer.
 - 2. P2: SSPC-SP2 - Hand Tool Cleaning.
 - 3. P3: SSPC-SP3 - Power Tool Cleaning
 - 4. P4:
 - a. Prepare concrete, concrete block, cement plaster, and drywall by removing all efflorescence, chalk, dust, dirt, grease, and other oils, and by roughening as required to remove glaze.
 - b. Scrap and grind fins and protrusions flush with surface.
 - c. Rake mortar joints clean.
 - d. Brush blast if recommended by coating manufacturer.

5. P5: SSPC-SP5 - White Metal Blast Cleaning.
 6. P6: SSPC-SP6 - Commercial Blast Cleaning.
 7. P7: SSPC-SP7 - Brush Off Blast Cleaning.
 8. P9:
 - a. Clean wood surfaces to be painted of all dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required.
 - b. Sandpaper smooth those finished surfaces exposed to view.
 9. P10: SSPC-SP10 - Near White Blast Cleaning.
 10. P11: SSPC-SP11 - Power Tool Cleaning to Bare Metal.
 11. P12: SSPC-SP12 - LP-WC/WJ-4: Pressure Wash
 12. P13: SSPC-SP13 - Surface Preparation of Concrete:
 - a. 4.3.1.: Abrasive Blast.
 - b. 4.3.2.: High Pressure Water Cleaning.
 13. P14: SSPC-SP16 - Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
 14. P15: NAF 500-03-04 Abrasive Blast Cleaning.
- L. Re-blast all Surfaces:
1. Where rusting has recurred.
 2. That do not meet the above requirements.

3.03 MATERIALS PREPARATION

- A. Mix and prepare materials in accordance with manufacturer's directions.
- B. Maintain containers used in mixing and application in a clean condition, free of foreign materials and residue.
- C. The following is prohibited:
 1. Field mixing of partial containers.
 2. Field mixing of lead abatement additive.
 3. Field tinting.

3.04 PRIMING

- A. Shop Priming: All steel and iron surfaces shall receive the following:
 1. Surface Preparation
 - a. SSPC-SP6 Commercial Blast Cleaning (Non-Immersion)
 - 1) Exterior of non-submerged ductile iron piping, fittings, valves, appurtenances, and I-beams and columns: SSPC-SP6 Commercial Blast Cleaning, surface profile of 2.0 to 2.5 mils.
 2. Coating:
 - a. Tnemec 161 or equal from Sherwin-Williams. 3.0 to 5.0 mils dry film thickness. Color shall be Tnemec 1255 Beige or equivalent.
 3. Whenever the shop priming coat has been damaged in transit or during construction, the metal shall be spot cleaned in accordance with the specified surface preparation and touched-up. Where the steel is delivered to the Site unprimed, it shall receive surface preparation and prime coating as required above.
- B. Field Priming: Non-ferrous and Galvanized Metals.
 1. Surface Preparation
 - a. Brush blast and clean entire surface to be coated to roughen steel and remove contaminants.
 2. Coating
 - a. Tnemec 161 or equal from Sherwin-Williams. 3.0 to 5.0 mils dry film thickness. Color shall be Tnemec 1255 Beige or equivalent.

3.05 APPLICATION

- A. Surface preparation and coating system are as indicated in the “Coating Schedule” at the end of this Section or noted on Drawings.
- B. Use equipment and techniques best suited for substrate and type of material being applied.
- C. Apply each coat at the rate specified for application by the manufacturer. All dry film thickness requirements must be met per this specification regardless of brush roll or spray application. Brush and Roller applications may require additional coats to meet the minimum requirement for each coat in each system.
 - 1. Do not apply in snow, rain, fog, mist, or damp surfaces.
 - 2. Allow wet surfaces to dry thoroughly and attain the temperature and conditions specified before proceeding with or continuing the painting operation.
 - 3. Work may continue during inclement weather only if areas and surfaces are enclosed and ambient conditions within the area can be maintained within limits specified during application and drying periods.
- D. Avoid degradation and contamination of surfaces and avoid intercoat contamination.
 - 1. Surfaces shall be free from grease, oil, abrasives, and other contaminants that may have an adverse effect on coating application, bonding, curing, or performance.
 - 2. Clean contaminated surfaces before applying next coat.
 - 3. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable system.
- E. Brush-apply primer or intermediate on all welds and edges prior to general application of finish coat.
- F. Apply caulking to flange interfaces, gaps, and intermittent weld seams.
- G. Provide finish coats that are compatible with primers used. Prime and intermediate coats shall be lighter than subsequent coat.
- H. All paint systems are “full coverage.” Where discrepancies between manufacturer’s square foot coverage and mil thickness occur, use mil thickness requirements.
- I. Where voids are present exposing the substrate or undercoats, apply additional coats until a uniform color and finish is obtained. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
- J. Do not apply additional coats until Engineer has had the opportunity to inspect and approve previous coat.
- K. Unless otherwise indicated, match color of adjacent walls or equipment when painting miscellaneous brackets, hangers, and supports.
- L. Smooth out runs or sags immediately, or remove and recoat entire surface.
- M. Stripe coat each coat onto bolts, edges, irregularities, welds, corners, joints, etc. by brush, in addition to spray application.
- N. Curing time shall not be determined by average curing time under ideal laboratory conditions. Drying time shall be construed to mean “under normal conditions.” Temperature, relative humidity, and other environmental factors must be observed. Where conditions are other than normal because of the weather or because painting must be done in confined spaces, longer curing and drying times will be necessary. Additional coats of material shall not be applied over previously applied coats until those coats are adequately cured and thoroughly dried. Units shall not be placed in service until coatings are properly cured and thoroughly dry.

- O. Where thinning is necessary, only the products of the manufacturer furnishing the paint for that particular purpose shall be accepted and all such thinning shall be done strictly in accordance with the manufacturers' instructions as well as with the full knowledge and approval of the Engineer.
- P. Protection of Materials Not To Be Painted: Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, etc. and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring any adjacent surfaces. Protect working parts of all mechanical and electrical equipment from damage during surface preparation and painting process. All openings in motors shall be masked to prevent paint and all other materials from entering the motors.
- Q. Paint shall not be applied in extreme heat, temperatures below or above manufacturer's recommendation as listed on the product data sheet, nor in dust, smoke-laden atmosphere, and damp or humid weather. Apply paint in strict accordance with all product data sheet recommendations.
- R. Abrasive blast cleaning shall not be performed whenever the relative humidity exceeds 85 percent, nor whenever the surface temperature is less than 5 degrees F above the dew point of the ambient air. Coating manufacturer's recommendations are to be strictly adhered to. Blast cleaned surfaces shall be primed prior to any evidence of rust bloom.
- S. Finish coats shall be uniform in color and sheen without streaks, laps, runs, sags, pinholes, missed areas, etc.
- T. In the event heating devices are used, they shall be explosion-proof and of the type that do not exhaust moisture, sooty or oily residues or any other contaminants into the structure, tank, building, etc. Forced air electric heat or heat exchangers with all combustion products positively vented to the exterior is required.
- U. Yellowing or any other discoloration of paint will be unacceptable and will require repainting at no additional expense to Owner. Contractor shall be responsible to provide all ventilation, heating, etc. to provide proper curing for painting and to prevent discoloration.
- V. Do not apply coatings to the following surfaces:
 - 1. Factory or installer-finished items.
 - a. Process piping valves with factory finishes shall be over-coated to match the adjacent systems. Coordinate coatings with manufacturer.
 - 2. Anodized aluminum, stainless steel, or other pre-finished metal.
 - a. All aluminum surfaces in direct contact with concrete shall receive one 8-12 mil dry film thickness bitumastic coating.
 - 3. Moving parts of operating devices.
 - 4. Sprinkler heads or other fire detection/suppression elements.
 - 5. Code required labels.
 - 6. Equipment nameplates.
- W. Ductwork and conduit exposed to view shall receive finish coatings the same color as walls and/or ceilings to which they are adjacent. Color selections to be made by Owner.

3.06 PIPE IDENTIFICATION

- A. All exposed interior and exterior piping having diameters 6-inches or larger shall receive stencil type painted identification utilizing Coating System Number S2. Piping smaller than 6-inches shall receive pipe markers per Section 40 23 00.
- B. Stencils shall be constructed of flexible plastic and shall be reusable.
- C. Stencil letters shall be upper case, 2-inches in height, and proportional in width.
- D. Stencils shall identify process or fluid conveyed and direction of flow.

- E. Each pipe identification stencil shall be constructed so that all letters and words contained in the identifying label are wholly complete and properly spaced. No combination of differently worded stencils shall be allowed to identify any one pipe.
- F. Each stencil shall have a 6-inch long by 1-inch wide direction of flow arrow included before and after the identifying words. The arrow on the left shall point left and the arrow on the right shall point right. When the stencil is painted on the pipe, the arrow indicating proper direction of flow shall also be painted while the other arrow is covered up.
- G. Stencils shall be cleaned and turned over to the Owner after all painting is complete.
- H. For bidding purposes, assume two (2) different stencils, each having two (2) arrows and twenty (20) letters each.
- I. A drawing and description of a typical stencil shall be submitted to the Engineer for approval and at that time a list will be provided of all stencils required.
- J. Placement:
 - 1. Each pipe shall be labeled with a minimum of two (2) stencils in each room.
 - 2. Stencils shall be applied on all branch lines of all header pipes.
 - 3. Stencils shall be installed on all header lines between branches.
 - 4. Where the same pipe goes through a wall or a piece of equipment, stencils on each side are required.
 - 5. Stencils for chemical piping shall in no case exceed 10-foot spacing.
- K. In no case on all other piping shall stencils exceed 20 foot spacing.

3.07 COLOR CODING

- A. Pipes Exposed or Concealed in Accessible Pipe Spaces:
 - 1. Provide with color band and arrow indicating direction of flow, and legend adjacent to valves, at not more than 10-foot spacing on straight pipe runs, adjacent to change in direction, and on both sides where pipes pass through walls or floors.
 - 2. Color-coding shall be based on pipe contents in accordance with the "Pipe Color Schedule" at the end of this Section, or noted on Drawings.
 - a. Ductile iron piping shall be entirely coated.
 - b. PVC piping shall be banded.
- B. Bands: Color and of width indicated.
- C. Arrows: Install adjacent to each band and legend to indicate direction of flow in pipe.
- D. Legends:
 - 1. Print in uppercase letters and letter sizes as listed in this Section to match "arrow".

3.08 QUALITY CONTROL

- A. Contractor shall provide all necessary equipment to monitor and record the information required on the Daily Application Record.
 - 1. Equipment shall be in good condition.
 - 2. Operational within its design range.
 - 3. Calibrated as required by the specified standard for use of each device.
- B. Maintain a copy of the following information at the site:
 - 1. Product Data Sheets.
 - 2. Safety Data Sheets (SDS).
 - 3. Contract Document and submittals.

- 4. Daily Application Record.
 - a. Record information (in English) on form located at the end of this Section.
- C. Owner's representative may be on site to observe the application of each coating, and the preparation of each substrate.
- D. Provide safe and complete access to all surfaces for observation by Owner and/or Engineer.
- E. Prepare rigging so that all surfaces are within arm's reach of observer.
- F. Measure wet paint with wet film thickness gages.
- G. Provide DFT measurements for all coatings in accordance with SSPC-PA2.
- H. Perform Holiday testing in accordance with NACE RPO 188 as directed by Engineer.
- I. Correct any deficiencies observed or detected by field testing as directed by Engineer.

3.09 DAMAGED COATINGS

- A. Damaged coatings and pinholes shall have the edges feathered and repaired in accordance with paint manufacturer's directions.
- B. All finish coats, including touch-up and damage-repair coats, shall be applied in a manner that will present an appearance of uniform color and texture.

3.10 UNSATISFACTORY APPLICATION

- A. If the item has an improper finish color or insufficient film thickness, the surface shall be cleaned and topcoated with the specified paint material to obtain the specified color and coverage. Specific surface preparation information shall be obtained from the paint manufacturer and the Architect.
- B. All visible areas of chipped, peeled, or abraded paint shall be hand or power sanded feathering the edges. The areas shall be primed and finish coated in accordance with the Specifications. Depending on the extent of repair and its appearance, a finish sanding and topcoat may be required by the Architect.
- C. Work shall be free of runs, bridges, shiners, laps, or other imperfections. Evidence of the conditions is grounds for rejection.
- D. Any defects in the coating system shall be repaired by the Contractor per written recommendations of the coating manufacturer.

3.11 CLEANING AND PROTECTION

- A. During progress of Work, remove discarded materials, rubbish, cans, and rags at end of each workday from the Site.
- B. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.
- C. Upon completion of Work:
 - 1. Clean window glass and spattered surfaces.
 - 2. Remove spattered paint by washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- D. Protect Work of other trades against damage. Correct any damage by cleaning, repairing or replacing, and repainting.

- E. Provide “Wet Paint” signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided for protection of Work, after completion of painting operations.
- F. At completion of Work of other trades, touch-up and restore damaged or defaced surfaces.

3.12 SCHEDULES

- A. See the following pages.

Coating Systems

SYSTEM NUMBER	TYPE	SUBSTRATE/ SERVICE	SURFACE PREP	MFG	FIRST COAT	DFT (Mils)	SECOND COAT	DFT (Mils)	FINISH COAT	DFT (Mils)	NOTES
D2	Epoxy	Ductile Iron Outside Diameter Interior Exposed	P15	SWC	Macropoxy 646	3.0-6.0	Macropoxy 646	3.0-6.0			
				TCI	Series N69	3.0-5.0	Series N69	4.0-6.0			Note: Can substitute N69 with Series 49 for low-VOC, high solids
NF1	Epoxy	Galvanized and Non Ferrous Metals Interior Exposed	P14	SWC	Macropoxy 646	3.0-6.0	Macropoxy 646	3.0-6.0			
				TCI	Series N69	2.0-3.0	Series N69	2.0-3.0			
PVC1	Epoxy	PVC Interior Exposed	P1a	SWC	Macropoxy 646	3.0-6.0	Macropoxy 646	3.0-6.0			
				TCI	Series N69	2.0-3.0	Series N69	2.0-3.0			

NOTES:

Any Secondary Chemical Containment and Immersion Grade Chemical Resistant commodities will be specified on case by case basis by the Protective Coatings Management Group in conjunction with Manufacturer's Chemical Resistant Guides.

Prepared concrete surfaces must be filled if the surface is too rough. Fairing the surface to fill bugholes and voids to near smooth is mandatory prior to coating application. Some surface texture after filling may be approved and recommended for adhesion of subsequent coats.

Optically Activated Pigment (OAP) which may be used for supplementary visual holiday detection. OAP is not a replacement for NACE standard SPO-188-2006.

ROOM FINISH SCHEDULE

LOCATION	COATING SYSTEM #	COATING TYPE
All Misc. Pipe		
Ductile Iron - Interior Exposure	D2	Epoxy
Non-Ferrous Metals - Pipe - Interior Exposure	NF1	Epoxy
PVC Process Piping	PVC1	Epoxy

**Water Treatment Plants and Pumping Stations
Piping Color Code**

USAGE	COMMODITY	COLOR STANDARD	SHERWIN WILLIAMS COLOR #	TNEMEC COLOR #
Water Lines	Raw	Olive Green	4024	112GN
	Settled or Clarified	Aqua	4061	10GN
	Finished or Potable	Dark Blue	4064	27BL
Chemical Lines	Alum or Primary Coagulant	Orange	4083	04SF
	Ammonia	White	Ultra White	11WH
	Carbon Slurry	Black	Black	35GR
	Caustic	Yellow with Green Band	4084/4071	02SF/08SF
	Chlorine	Yellow	4084	02SF
	Chlorine Dioxide	Yellow with Violet Band	4084/4080	02SF/14SF
	Fluoride	Light Blue with Red Band	4061/4081	37BL/06SF
	Lime Slurry	Light Green	4069	52GN
	Ozone	Yellow with Orange Band	4084/4083	02SF/04SF
	Phosphate Compounds	Light Green with Red Band	4069/4081	52GN/06SF
	Polymers or Coagulant Aids	Orange with Green Band	4083/4071	04SF/08SF
	Potassium Permanganate	Violet	4080	14SF
	Soda Ash	Light Green with Orange Band	4069/4083	52GN/04SF
	Sulfuric Acid	Yellow with Red Band	4084/4081	02SF/06SF
	Sulfur Dioxide	Light Green with Yellow Band	4069/4084	52GN/02SF
Waste Lines	Backwash Waste	Light Brown	4001	40BR
	Sludge	Dark Brown	4009	84BR
	Sewer	Dark Gray	4025	55BL
Other	Compressed Air	Dark Green	4071	08SF
	Gas	Red	4081	06SF
	Other Lines	Light Gray	4026	32GR

END OF SECTION

DAILY APPLICATION RECORD

DATE				-----RECORD EVERY 3 HOURS-----					
				Surface Temperature (Deg. F.)	Air Temperature (Deg. F.)	Material Temperature (Deg. F.)	Relative Humidity (%)	Dew Point (Deg. F.)	Weather Conditions
TIME START		AM	PM						
		AM	PM						
		AM	PM						
		AM	PM						
		AM	PM						
TIME STOP		AM	PM						

Area Prepared	
Area Coated	
Type of Material & Quantity Applied:	

SIGNED

PROJECT NAME: OWNER:	SEH FILE #: CONTRACTOR:
---------------------------------------	--

SECTION 26 00 00

GENERAL PROVISIONS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 GENERAL

- A. Scope of Work:
 - 1. The work included under Division 26 shall consist of furnishing labor and materials necessary for the complete installation of the electrical systems shown on the Contract Drawings and described in the Specifications. This shall include minor items which are necessary to complete the installation and usually included in similar work even though not specifically mentioned in the Contract Documents.
 - 2. Contractor shall walk through the installation at site with Owner's representative prior to mounting equipment and routing conduit.
 - 3. Include minor items which are obviously and reasonably necessary to complete the installation and usually included in similar work even though not specifically mentioned in the Contract Document.
 - 4. Deviations due to a particular manufacturer's requirements shall be provided at no additional cost.
 - 5. Contractor is responsible for the coordination of the installation of electrical equipment with other trades. Where conflicts between disciplines arise, contact the Engineer prior to equipment installation.
 - 6. Factory-trained manufacturer's representative to provide operator training.
 - 7. Provide as-built drawings and documents. Coordinate with Engineer and Client on requirements.
- B. Related Requirements:
 - 1. The Contractor is responsible for information contained in the Division 26 Specifications in addition to electrical requirements and information contained in other divisions.
 - 2. Where a Specification Section refers to other sections under the Article of Related Requirements, this is done for Contractor's Convenience only. It shall not relieve the Contractor of responsibilities stated in other Sections of the Specifications. The Contractor is responsible for information contained in this division's Specifications as well as for electrical requirements and information contained in other divisions.

1.03 PERMITS, LICENSES, AND FEES

- A. Provide temporary and permanent permits and licenses required for the completion of the work included under this contract. Fees and expenses required to obtain such permits shall be paid for by the Contractor.
- B. Provide inspections as required by regulating agencies or where required by code. Include and pay charges for inspection agencies and provide Owner with a certificate of final inspection and approval by the authority having jurisdiction.
- C. Refer to General Conditions for state and local sales tax requirements.

1.04 REFERENCES

- A. Material and workmanship to comply with applicable codes. As a minimum include State and Federal laws, local ordinances, Utility Company regulations and requirements and interpretations of the following by the local authority having jurisdiction:
 - 1. State and Local Building Codes.
 - 2. State and Local Fire Codes.
 - 3. National Electrical Code.
 - 4. State and Local Electrical Codes.
 - 5. OSHA Regulations.
- B. If drawings and specifications are against these codes, notify the Engineer prior to rough-in.
- C. The following is list of organizations and their abbreviations where referred to in the specifications as standards of construction:
 - 1. ANSI – American National Standard Institute.
 - 2. ASHRAE – American Society of Heating, Refrigeration and Air Conditioning Engineers.
 - 3. ADA – Americans with Disabilities Act.
 - 4. ASTM – American Society for Testing and Materials.
 - 5. FM – Factory Mutual.
 - 6. IRI – Industrial Risk Institute.
 - 7. IEEE – Institute of Electrical and Electronic Engineers.
 - 8. NBFU – National Board of Fire underwriters.
 - 9. NBS – National Bureau of Standards.
 - 10. NEC – National Electrical Code.
 - 11. NEMA – National Electrical Manufacturers Association.
 - 12. NFPA – National Fire Protection Agency.
 - 13. OSHA – Occupational Safety and Health Administration.
 - 14. UL – Underwriters' Laboratories, Inc.

1.05 DEFINITIONS

- A. The terms listed below are defined as followed:
 - 1. Furnish: Obtain, coordinate, deliver to the job site and guarantee.
 - 2. Install: Furnished by others, receive on site, unload, store, set in place, connect, place in operation and guarantee workmanship of installation.
 - 3. Provide: Furnish and install.
 - 4. Connect: Bring service to the equipment and make final attachments, including necessary disconnect switches, control switches, outlets, etc.
 - 5. Conduit: Electrical conduit and associated fittings, hangers, pull boxes, supports, etc. as required for a complete and proper installation.
 - 6. Concealed: Hidden from sight in walls, ceilings, or floors.
 - 7. Exposed: Surface mounted, not hidden from site.
 - 8. Building Structure: Columns and beams.
 - 9. Relocate: Existing equipment to be relocated to new location and existing conduit and branch circuiting (conductors) to be extended to new location and reconnected.
 - 10. Circuitry: Conduit, conductors, and connections for a complete operational system.

1.06 SUBMITTALS

- A. Substitutions shall be submitted through a bidding contractor and submitted to engineer (10) working days prior to bid opening. Include detailed information concerning substitution. Acceptable substitutions will be issued in an addendum to the Contract Documents prior to bid date. Extra costs incurred because of substitution, including those of other contractors are the responsibility of the submitting contractor, including engineering redesign cost.
- B. Shop drawing submittals shall be done in accordance with the General Conditions and as listed under Division 1. Submit copies for each item as required per individual section of the specifications.

- C. Submit Record Drawings in accordance with the General Conditions and as listed under Division 1. Record Drawings shall consist of one complete set marked up with changes completed during construction. Multiple set of markups is will not be accepted and must be transferred to one site prior to submittal.
- D. Submit Operating, Maintenances and Warranty Data Manuals in accordance with the General Conditions and as listed in Division 1.

1.07 PROJECT/SITE CONDITIONS

- A. Inspection of Site: Before submitting a proposal on the Work, the Contractor and Subcontractors shall examine the site of the proposed work and thoroughly familiarize themselves with existing conditions and limitations affecting the performance of their Work. No extra compensation will be allowed because of a misunderstanding as to the amount of Work involved or lack of knowledge of existing conditions which could have been discovered or reasonable anticipated prior to bidding.
- B. Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes to work specified in other sections. Obtain permission of Engineer before proceeding.

1.08 STORAGE AND HANDLING

- A. Protect electrical equipment and components stored or installed on-site with polyethylene or equivalent covering to protect from moisture, plaster, cement, paint, or work of other trades.
- B. Additional protective coverings may be constructed of plywood sheeting for additional strength.
- C. Replace or touch up and refinish surfaces of original finishes that becomes chipped or scratched during shipment or installation.

1.09 TEMPORARY ELECTRICAL SERVICE

- A. Provide and maintain electrical power service for the use of all trades during construction.
 - 1. Contractor is responsible for all costs and charges associated with the temporary power connection and service for the duration of the construction period.
 - 2. Provide and maintain a complete temporary lighting services for use by all trades during construction.
 - a. Provide adequate lighting suitable for conditions for high quality workmanship and for safety throughout the area of construction.
 - b. Provide and maintain an exit and safety lighting system where required by code or OSHA.
 - 3. Refer to General Conditions for additional temporary power service requirement details.
 - 4. Refer to General Conditions for any phasing or additional requirements.
- B. Provide and maintain a complete temporary power system for facilities being removed but are to remaining functional until new facilities are operations. See sequence of construction.
- C. Provide and maintain services to existing facilities until new facilities are operational. See sequence of operation to sequence electrical services.

1.10 EQUIPMENT SIZE COORDINATION

- A. Equipment placement on design drawings is based on one manufacturer's dimensions. Coordinate the actual size of manufacturer used with the spaces available and alert Engineer if there is issue with fitting the proposed equipment into the space.
- B. Investigate each space in structure through which equipment must pass to reach its final location. Coordinate shipping splits with manufacturer to permit safe handling and passage through restricted areas in structure.

- C. Equipment shall always be kept upright during storage and handling. When equipment must be tilted for passage through restricted areas, brace equipment to ensure that tilting does not impair the functional integrity of equipment.

1.11 TEMPORARY SHUTDOWNS AND ABANDONED SERVICES

- A. Where the work makes temporary shutdowns unavoidable, contractor shall consult with owner as to times and procedures for such shutdowns. Where existing services are abandoned, wiring shall be removed, and conduit shall be properly capped in conformance with the requirements of the utility.
- B. Existing systems are to remain functional until new facilities are complete and operational.

1.12 SEQUENCING AND SCHEDULING

- A. Install work to accommodate Owner's occupancy requirements during construction period and coordinate electrical schedule and operations with owner.
- B. Construct work in a sequence under provisions of Division 01 – General Requirements and other sections as applicable.
- C. Electrical work shall be coordinated with other trades and contractors to expedite completion of project.
- D. It will be the contractor's responsibility to examine the drawings and specifications, to take measurements where required to verify dimensions for correct placement of equipment and to progress the contract as expeditiously as possible, so that the progress of the work is orderly and does not cause unnecessary cutting and patching of structures. The contractor shall be responsible for cutting and patching of structures made necessary by the failure to install sleeves, grilles or other items required by the electrical work at the proper time for the normal installation of such items.
- E. The determination of quantities of material and equipment required shall be made by the contractor based on the contract documents. Schedules on the drawings and in the specifications are completed as an aid to the contractor but where discrepancies arise, the actual number required shall govern.

1.13 RECORD UTILITIES DRAWINGS

- A. Contractor shall prepare and submit to Engineer, drawings showing the exact location of all installed underground electrical and conduit runs, and any existing underground utilities encountered during installation. The drawings shall give accurate locations (referenced to visible above-grade objects) and dimensions of all such equipment for future use by the owner. These drawings shall be submitted to Engineer as soon as possible after such runs have been installed.

1.14 WARRANTY

- A. Provide a guarantee of workmanship and material and keep same in good operating condition for a period of two (2) years after final completion of the work as evidenced by issuance of final completion certificate by the Engineer.
- B. Correct defects immediately and at contractors' expense those defects due to faulty workmanship or materials that arise during the above-mentioned period and make corrections to the satisfaction of the Engineer. Such reconstruction and repairs shall include damages to the finish of the building resulting from the original defect.
- C. The guarantee shall not apply where other guarantees for different lengths of time are specifically called for.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 ROUGH-IN

- A. Verify location for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Consult the Contract Documents (Drawing and Specifications) of other Divisions and other trades for correlating information and layout work so that it will not interfere with other trades. Verify dimensions and conditions, i.e., finished ceiling heights, wall elevations, sections, footing and foundation elevations, beam depths, ductwork and piping etc. with architectural, mechanical, civil, and structural drawings. If conflicts occur such that resolution is not possible by the affected trades on the job, notify the Engineer so a resolution can be worked out. Where work must be replaced due to failure to verify conditions existing on the job, such replacement shall be accomplished at no extra cost to the owner. This shall apply to shop fabricated Work as well as work fabricated in place.

3.02 INSTALLATION

- A. Arrange for chases, slots, and openings in other building components during the progress of construction to allow for electrical installation.
- B. Install material and equipment in accordance with manufacturers' recommendations, instructions and current NECA, NFPA 70 and UL standards.
- C. Install equipment and materials to provide required access for servicing and maintenance. Coordinate equipment location with required access panels and doors. Allow ample space for removal of parts that require replacement or servicing.
- D. Coordinate the installation of required supporting devices and sleeves with structural systems.
- E. Coordinate with other trades before installing equipment so that conflicts will be resolved before installation. In general, large mechanical equipment shall be given priority. Maintain, wherever practical, a minimum separation of 3" from water and waste piping and 12" from hot water and steam piping.
- F. Electrical Equipment, outlet boxes, etc. shall not be attached or otherwise fastened to ductwork or other mechanical equipment unless noted otherwise.
- G. Cutting and patching shall be performed in accordance with the provisions of the general conditions.
- H. Install systems, materials, and equipment level and plumb, parallel, and perpendicular to other building systems and components, where installed exposed unless noted otherwise.
- I. Drilling:
 - 1. Drill holes in masonry with rotary drills.
 - 2. Properly seal penetrations with an approval fire-rated sealant.
 - 3. Verify fire rating of walls prior to work and restore to required fire rating.

3.03 PROTECTION

- A. Contractor shall be responsible for damage to electrical equipment or materials. Equipment installed by the Contractor shall be kept in a clean and functional condition until final acceptance by the Owner.

- B. When a portion of the building is to be occupied by the Owner prior to Substantial Completion of the entire Project, arrangements will be made to transfer responsibility for protection and housekeeping tasks from the Contractor to Owner.
- C. There shall be no interruptions of building systems during occupied times without prior arrangement.

3.04 CLEANING

- A. Keep the premises free from the accumulation of waste materials or rubbish caused by execution of the Work. At the completion of the Work, remove rubbish, tools, scaffolding and surplus material from and about the premises. The premises shall be "broom-cleaned" or its equivalent unless more thorough cleaning is specified elsewhere.

3.05 PAINTING

- A. Refinish electrical equipment damaged during shipping or installation to its original condition. Remove rust, prime and paint per manufacturer's recommendations for finished equal to original. Do not paint nameplates, labels, tags, stainless steel, or items such as shafts, levels, handles, trim or terminal strips.
- B. Conduit and raceway systems shall be unpainted unless specifically noted. If painting of conduit and raceway systems is required, coat with paint type and color to match background mounting surface.
- C. Touch-up paint shall be applied to equipment with chips or scratch marks.

3.06 OPENINGS, CUTTING AND PATCHING

- A. The contractor shall coordinate the placing of openings in structures as required for the installation of electrical work.
- B. The contractor shall coordinate the accurate location and size for required openings and shall assure that the proper size openings are provided. Openings shall be patched and/or sealed.
- C. Contractor shall provide cutting and patching as required for the installation of the work and shall furnish lintels and supports as required for openings. Cutting of the structural members will not be permitted without prior approval of the Engineer. Extent of the cutting shall be minimized by use of core drills, power saws or other machines which will provide neat, minimum openings. Patching shall match adjacent materials and surfaces and shall be performed by craftsman skilled in the respective discipline.

3.07 TEST AND DEMONSTRATIONS

- A. Systems shall be tested and placed in proper working order prior to demonstrating to Owner.
- B. Prior to acceptance of the electrical installation, the contractor shall demonstrate to the Owner or Owner's designated representative all essential features and functions of the systems installed and shall instruct the owner in the proper operation and maintenance of such systems.
- C. Contractor shall furnish the necessary trained personnel to perform to demonstrations and training and shall arrange to have the manufacturers' representatives for the system present to assist with the demonstration, the owner and contractor shall each sign a certification stating that the training has been performed and the owner accepts the same.

END OF SECTION

SECTION 26 05 01

ELECTRICAL DEMOLITION

PART 1 GENERAL

1.01 SCOPE

- A. This Section covers basic electrical requirements for providing labor, materials, equipment, and services necessary to complete all the demolition required for the project as specified herein and shown on the drawings.

1.02 INTENT

- A. It is the intent of this specification and accompanying drawings to describe the overall scope of demolition work to be performed. It is not intended that the specifications and drawings show every piece of equipment required to be removed.
- B. The contractor shall disconnect and remove electrical items as indicated on the drawings, or as required by the project.
- C. The contractor shall seal floor, wall and ceiling openings with thermo-setting fire resistive compound after removal of conduits.
- D. The Water Treatment Plant shall be capable of operating at all times.

1.03 JOB OVERVIEW

- A. The electrical contractor shall disconnect all electrical equipment and devices in the construction documents for either relocation or removal, at the existing Elk River, Well 7/9 MN Water Treatment Plant.

PART 2 PRODUCT

Not Used

PART 3 EXECUTION

3.01 DEMOLITION/ALTERATION

- A. Prior to start of demolition, disconnect power and control at the source. Contractor shall verify using an electrical meter or other device to ensure that power has been disconnected at the source of supply.
- B. Demolition shall be performed in such a manner as to avoid hazards to persons and property. Work shall be performed in strict accordance with all Municipal, State and Federal Rules, Regulations, Codes, and Laws which may govern and apply to this work.
- C. Maintain continuous service of feeders, circuits or partial circuits, and outlets affected by this work, except where written permission for an outage for a specified time has been granted. All work requiring shut down of existing systems shall be coordinated and approved by Owner prior to work starting.
- D. Provide reconnection and temporary installation as required; remove at job completion.

- E. Cut back to floor, wall, or ceiling and plug ends of concealed conduits made obsolete. Remove exposed conduits, wireways, outlet boxes, hangers, and devices made obsolete by this work unless designated specially to remain.
- F. Provide blank plates on all unused outlet boxes.
- G. Wherever extensions of wires or cables are shown on drawings, check and verify wire and cables size and capacities. Secure Engineer acceptance of this data before new cables are ordered or installation starts.
- H. The Owner reserves the right to claim any materials removed during demolition that will not be reused.
- I. Repair existing surfaces back to original condition.
- J. Where equipment is shown to be removed, the contractor shall also remove the associated electrical conduits back to their sources, or back to the nearest junction if the circuit needs to remain to service equipment not being removed.

3.02 WASTE MANAGEMENT

- A. Contractor is responsible to remove from the site all material not salvaged or retained by the owner.
- B. The contractor shall be responsible for all damage to existing materials not affected by the demolition work. The contractor shall repair or replace damaged material or equipment as directed at no additional cost to the owner.

END OF SECTION

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Copper building wire rated 600 V or less.
 - 2. Tray cable, Type TC, rated 600 V or less.
 - 3. Connectors, splices, and terminations rated 600 V and less.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 PRODUCTS

2.01 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpha Wire Company.
 - 2. American Insulated Wire Corporation.
 - 3. Belden Inc.
 - 4. Cerro Wire LLC.
 - 5. Encore Wire Corporation.
 - 6. General Cable Corporation.
 - 7. Southwire Company.
 - 8. WESCO
 - 9. Approved Substitution.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Conductor Insulation:
 - 1. Type THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.

2.02 TRAY CABLE, TYPE TC

- A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in a nonmetallic jacket.
- B. Manufacture: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpha Wire Company.
 - 2. American Insulated Wire Corporation.
 - 3. Belden Inc.
 - 4. Cerro Wire LLC.
 - 5. Encore Wire Corporation.
 - 6. General Cable Corporation.
 - 7. Southwire Company.
 - 8. WESCO
 - 9. Approved Substitution.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Comply with UL 1277.
 - 4. Comply with ICEA S-73-532/NEMA WC 57 for Type TC cables used for control, thermocouple extension, and instrumentation.
 - 5. Comply with ICEA S-95-658/NEMA WC 70 for Type TC cables used for power distribution.
 - 6. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Ground Conductor: Insulated.
- F. Conductor Insulation: Type XHHW-2. Comply with UL 44.
- G. Shield: Metallic.

2.03 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacture: Subject to compliance with requirements, provide products by one of the following:
 - 1. 3M Electrical Products.
 - 2. AFC Cable Systems.
 - 3. Gardner Bender.
 - 4. Hubbell Power Systems, Inc.
 - 5. Ideal Industries, Inc.
 - 6. ILSCO.
 - 7. NSi Industries LLC.
 - 8. O-Z/Gedney.
 - 9. Service Wire Co.
 - 10. Approved Substitution.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.

2. Type: One or two hole with standard barrels.
3. Termination: Compression.

PART 3 EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.
- B. Feeders: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.
- C. Branch Circuits: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.
- D. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.04 MINIMUM SIZES

- A. Minimum control circuit conductor sizes:
 1. Class 1 remote-control and signal circuits; No 16 AWG.
 2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
 3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 14 AWG.
- B. Minimum building wire and power conductor size shall be No. 12 AWG for power and lighting circuits, and No. 14 AWG for control circuits. In order to minimize voltage drop for longer runs, the following minimum conductor sizes apply:
 1. 20A, 120V circuits longer than 75 feet: No. 10 AWG minimum.
 2. 20A, 120V circuits longer than 150 feet: No. 8 AWG minimum.

3. 20A, 120V circuits longer than 300 feet: No. 6 AWG minimum
4. 20A, 277V circuits longer than 150 feet: No. 10 WG minimum.
5. 20A, 277V circuits longer than 300 feet: No. 8 AWG minimum.

3.05 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.06 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.07 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.08 FIELD QUALITY CONTROL

- A. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements:
 1. Medium voltage cables
 2. Equipment rated 100A or greater.
 - a. Perform each of the following visual and electrical tests:
 - 1) Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - a) Test bolted connections for high resistance using one of the following:
 - (1) low-resistance ohmmeter.
 - (2) Calibrated torque wrench.
 - (3) Thermographic survey.
 - 2) Inspect compression-applied connectors for correct cable match and indentation.
 - 3) Inspect for correct identification.
 - 4) Inspect cable jacket and condition.
 - 5) Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - 6) Continuity test on each conductor and cable.
 - 7) Uniform resistance of parallel conductors.
- B. Perform each of the following visual and electrical tests on all other equipment:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.

- f. Test receptacles for polarity and continuity.
- C. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION

This Page Left Blank Intentionally

CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Category 6 balanced twisted pair cable.
 - 2. Balanced twisted pair cabling hardware.
 - 3. Low-voltage control cabling. (Shielded)
 - 4. Control-circuit conductors.
 - 5. Identification products.

1.03 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.05 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.
- B. Field quality-control reports.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.02 CATEGORY 6 BALANCED TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.
- B. Manufacture: Subject to compliance with requirements, provide products by one of the following:

1. 3M Company.
 2. AMP NETCONNECT.
 3. Belden Inc.
 4. Berk-Tek Leviton.
 5. CommScope, Inc.
 6. General Cable Corporation.
 7. Hitachi Cable America, Inc.
 8. Mohawk.
 9. Approved Substitution.
- C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- D. Conductors: 100-ohm, 23 AWG solid copper.
- E. Shielding/Screening: Unshielded twisted pairs (UTP).
- F. Cable Rating: Plenum.
- G. Jacket: Blue thermoplastic
- H. 600V insulation.

2.03 BALANCED TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate balanced twisted pair copper communications cable.
- B. Manufacture: Subject to compliance with requirements, provide products by one of the following:
1. 3M Company.
 2. AMP NETCONNECT.
 3. Belden Inc.
 4. Berk-Tek Leviton.
 5. CommScope, Inc.
 6. General Cable Corporation.
 7. Hitachi Cable America, Inc.
 8. Mohawk.
 9. Approved Substitution.
- C. General Requirements for Balanced Twisted Pair Cable Hardware:
1. Comply with the performance requirements of Category 6.
 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 3. Cables shall be terminated with connecting hardware of same category or higher.
- D. Connecting Blocks: Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
- E. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
1. Features:
 - a. Universal T568A and T568B wiring labels.
 - b. Labeling areas adjacent to conductors.
 - c. Replaceable connectors.
 - d. 24 or 48 ports.
 2. Construction: 16-gauge steel and mountable on 19-inch, (483 mm), equipment racks.
- F. Patch Cords: Factory-made, four-pair cables in 36-inch, (900-mm) lengths; terminated with an eight-position modular plug at each end.
1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.

- G. Plugs and Plug Assemblies:
 - 1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded balanced twisted pair cable.
 - 2. Comply with IEC 60603-7-1, IEC 60603-7-2, IEC 60603-7-3, IEC 60603-7-4, and IEC 60603-7.5.
- H. Jacks and Jack Assemblies:
 - 1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded balanced twisted pair cable.
 - 2. Designed to snap-in to a patch panel or faceplate.
 - 3. Standards:
 - a. Category 5e, unshielded balanced twisted pair cable shall comply with IEC 60603-7-2.
 - b. Category 5e, shielded balanced twisted pair cable shall comply with IEC 60603-7-3.
 - c. Category 6, unshielded balanced twisted pair cable shall comply with IEC 60603-7-4.
 - d. Category 6, shielded balanced twisted pair cable shall comply with IEC 60603-7.5.
 - e. Category 6a, unshielded balanced twisted pair cable shall comply with IEC 60603-7-41.
 - f. Category 6a, shielded balanced twisted pair cable shall comply with IEC 60603-7.51.
- I. Faceplate:
 - 1. Two port, vertical single-gang faceplates designed to mount to single-gang wall boxes.
 - 2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
 - 3. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
 - 4. For use with snap-in jacks accommodating any combination of balanced twisted pair, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
- J. Legend:
 - 1. Machine printed, in the field, using adhesive-tape label.
 - 2. Snap-in, clear-label covers and machine-printed paper inserts.

2.04 LOW VOLTAGE CONTROL CABLE (SHIELDED)

- A. Standard Cable: NFPA 70, Type CM.
 - 1. Paired, one pairs, No. 16 AWG, stranded (9x29) tinned-copper conductors.
 - 2. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 - 3. PVC jacket.
 - 4. Flame Resistance: Comply with UL 1685.
 - 5. 600volt rated
 - 6. Belden 8719 or equal.

2.05 CONTROL-CIRCUIT CONDUCTORS

- A. Manufacture: Subject to compliance with requirements, provide products by one of the following:
 - 1. 3M Company.
 - 2. AMP NETCONNECT.
 - 3. Belden Inc.
 - 4. Berk-Tek Leviton.
 - 5. CommScope, Inc.
 - 6. General Cable Corporation.
 - 7. Hitachi Cable America, Inc.
 - 8. Mohawk.
 - 9. Approved Substitution.
- B. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway, Type XHHW-2, complying with UL 44 in raceway.
- C. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway, Type XHHW-2, complying with UL 44 in raceway.

- D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway, Type XHHW-2, complying with UL 44 in raceway.

PART 3 EXECUTION

3.01 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
- B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.
- D. Backboards: Install backboards with 96-inch, (2440-mm), dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.02 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1 and NFPA 70.
- B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C Series of standards.
 - 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
 - 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 - 4. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
 - 5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
 - 6. Secure and support cables at intervals not exceeding 30 inches, (760 mm), and not more than 6 inches, (150 mm), from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
 - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
 - 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
 - 10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
 - 11. Support: Do not allow cables to lie on removable ceiling tiles.
 - 12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
 - 13. Provide strain relief.
 - 14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
 - 15. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.
- C. Balanced Twisted Pair Cable Installation:
 - 1. Comply with TIA-568-C.2.
 - 2. Do not untwist balanced twisted pair cables more than 1/2 inch, (12 mm), at the point of termination to maintain cable geometry.

- D. Installation of Control-Circuit Conductors:
 - 1. Install wiring in raceways.
 - 2. Use insulated spade lugs for wire and cable connection to screw terminals.
 - 3. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- E. Separation from EMI Sources:
 - 1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
 - 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches, (127 mm).
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches, (305 mm).
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches, (600 mm).
 - 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches, (64 mm).
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches, (150 mm).
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inches, (305 mm).
 - 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches, (75 mm).
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches, (150 mm).
 - 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches, (1200 mm).
 - 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches, (127 mm).

3.03 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.04 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
 - 1. Class 1 remote-control and signal circuits; No 16 AWG.
 - 2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
 - 3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 14 AWG.

3.05 GROUNDING

- A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

3.06 IDENTIFICATION

- A. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.
- B. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

3.07 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
- B. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Steel slotted support systems.
 - 2. Aluminum slotted support systems.
 - 3. Nonmetallic slotted support systems.
 - 4. Conduit and cable support devices.
 - 5. Support for conductors in vertical conduit.
 - 6. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

1.03 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.04 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.

1.05 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.06 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.
- C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

PART 2 PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-, (10-mm-), diameter holes at a maximum of 8 inches, (200 mm), o.c. in at least one surface.
 - 1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. B-line.
 - c. CADDY.
 - d. Flex-Strut, Inc.
 - e. G-Strut.
 - f. GThomas & Betts Corporation.
 - g. Approved Substitution.
 - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Material for Channel, Fittings, and Accessories: Galvanized steel or Stainless steel, type 316.
 - 4. Channel Width: Selected for applicable load criteria.
 - 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32-inch-, (10-mm-), diameter holes at a maximum of 8 inches, (200 mm), o.c. in at least one surface.
 - 1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Industries, Inc.
 - b. Flex-Strut, Inc.
 - c. Haydon Corporation.
 - d. MKT Metal Manufacturing.
 - e. Approved Substitution.
 - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Channel Material: 6063-T5 aluminum alloy.
 - 4. Fittings and Accessories Material: 5052-H32 aluminum alloy.
 - 5. Channel Width: Selected for applicable load criteria.
 - 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with minimum 13/32-inch-, (10-mm-), diameter holes at a maximum of 8 inches, (200 mm), o.c., in at least one surface.
 - 1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. B-line.
 - c. Fabco Plastics Wholesale Limited.
 - d. G-Strut.
 - e. Approved Substitution.
 - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Channel Width: Selected for applicable load criteria.
 - 4. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
 - 5. Fitting and Accessory Materials: Same as those for channels and angles except metal items may be stainless steel.
 - 6. Rated Strength: Selected to suit applicable load criteria.

7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Conduit and Cable Support Devices: Steel and malleable-iron, or stainless steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325, (Grade A325M).
 6. Toggle Bolts: Stainless-steel springhead type.
 7. Hanger Rods: Threaded steel.

PART 3 EXECUTION

3.01 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
1. NECA 1.
 2. NECA 101
 3. NECA 102.
- B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch, (6 mm), in diameter.

3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Classified spaces shall use aluminum or stainless steel support channel and hardware.
- C. Damp and wet locations use aluminum or stainless steel support channel and hardware.
- D. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb, (90 kg).

- E. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69 or Spring-tension clamps.
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- F. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils, (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Conduit Seals
 - 5. Boxes, enclosures, and cabinets.
 - 6. Handholes and boxes for exterior underground cabling.

1.03 DEFINITIONS

- A. EMT: Electrical Metallic Tubing.
- B. IMC: Intermediate Metal Conduit.
- C. RMC: Rigid Metal Conduit.
- D. GRC: Galvanized Rigid Steel Conduit.
- E. PVC-GRC: PVC Coated Galvanized Rigid Steel Conduit.
- F. FMC: Flexible Metal Conduit.
- G. LFMC: Liquid Tight Flexible Metal Conduit.
- H. RNC: Rigid non-metallic conduit.

1.04 SUBMITTALS

- A. Product Data: For surface raceways, hinged-cover enclosures, and cabinets.

PART 2 PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
 - 1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems.
 - b. Allied Tube & Conduit.
 - c. Anamet Electrical, Inc.
 - d. Calconduit.
 - e. Electri-Flex Company.
 - f. FSR, Inc.
 - g. Korkap.

- h. NEC, Inc.
 - i. Opti-Com Manufacturing Network, Inc. (OMNI)
 - j. O-Z/Gedney.
 - k. Patriot Aluminum Products, LLC.
 - l. Perma-Cote.
 - m. Picoma Industries, Inc.
 - n. Plasti-Bond.
 - o. Approved Substitution.
 - 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. GRC: Comply with ANSI C80.1 and UL 6.
 - a. Metallic zinc applied by hot-dipped galvanizing or electro-galvanizing.
 - b. Threads galvanized after cutting.
 - c. Internal coating: Baked lacquer, varnish or enamel for a smooth surface.
 - 4. RAC: Comply with ANSI C80.5 and UL 6A.
 - a. 6063 Aluminum Alloy, T-1 temper.
 - 5. IMC: Comply with ANSI C80.6 and UL 1242.
 - 6. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - a. Comply with NEMA RN 1.
 - b. Coating Thickness: 0.040 inch, (1 mm), minimum, Polyvinyl Chloride Exterior Coating:
 - 1) Coating: Bonded to hot-dipped galvanized rigid steel conduit conforming to NEMA/ANSI C80.1.
 - 2) The bond between the PVC Coating and the conduit surface: Greater than tensile strength of the coating.
 - c. Nominal 0.020 inch, (.5 mm), minimum urethane interior coating.
 - d. Urethane coating on threads.
 - e. Conduit: Epoxy prime coated prior to application of PVC and urethane coatings.
 - 7. EMT: Comply with ANSI C80.3 and UL 797.
 - a. Mild steel with continuous welded seam.
 - b. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing.
 - c. Internal coating: Baked Lacquer, varnish or enamel for a smooth surface.
 - 8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
 - a. Flexible steel conduit with PVC jacket and complying with UL 360.
 - b. Core formed of continuous, spiral wound, hot-dipped galvanized steel with successive convolutions securely interlocked.
 - c. Extruded PVC outer jacket positively locked to the steel core.
 - d. Liquid and vaportight.
- B. Metal Fittings:
- 1. Comply with NEMA FB 1 and UL 514B.
 - 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. Fittings, General: Listed and labeled for type of conduit, location, and use.
 - 4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
 - 5. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Compression.
 - 6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, (1 mm), with overlapping sleeves protecting threaded joints.
- C. Joint Compound for IMC, GRC, or RAC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS AND FITTINGS

- A. Nonmetallic Conduit:

1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems.
 - b. Anamet Electrical, Inc.
 - c. Arnco Corporation.
 - d. CANTEX Inc.
 - e. CertainTeed Corporation.
 - f. Champion Fiberglass, Inc.
 - g. Condux International, Inc.
 - h. Electri-Flex Company
 - i. FRE Composites.
 - j. Kraloy.
 - k. Lamson & Sessions.
 - l. Niedax Inc.
 - m. RACO; Hubbell.
 - n. Thomas & Betts Corporation.
 - o. Approved Substitution.
 2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 3. RNC: Type EPC-40-PVC, Type EPC-80-PVC.
 - a. Complying with NEMA TC 2 and UL 651 unless otherwise indicated.
 - b. Polyvinyl-chloride (PVC) plastic compound.
 - c. Rated for direct sunlight exposure where installed exposed.
 - d. Fire retardant and low smoke emission.
 - e. Suitable for use with 90 Degree C wire.
 4. LFNC: Comply with UL 1660.
- B. Nonmetallic Fittings:
1. Fittings, General: Listed and labeled for type of conduit, location, and use.
 2. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
 3. Fittings for LFNC: Comply with UL 514B.
 4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.03 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufactures: Subject to compliance with on for the following:
1. Cooper B-Line, Inc.
 2. Hoffman.
 3. Mono-system, Inc.
 4. Square D.
 5. Anamet Electrical, Inc.
 6. Approved Substitution.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R, Type 4, Type 12, as required by the installation, and sized according to NFPA 70.
1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type or Flanged-and-gasketed type depending on the installation.
- E. Finish: Manufacturer's standard enamel finish.
- F. Not permitted without submittal and prior approval by Engineer.

2.04 CONDUIT SEALS

- A. Conduit seals shall be provided wherever conduits penetrate exterior concrete walls below grade, or cross hazardous location boundaries:
 - 1. For conduits less than 60 inches below grade; OZ/Gedney Type FSK, or equal.
 - 2. For conduits more than 60 inches below grade; OZ/Gedney Type WSK, or equal.

2.05 BOXES, ENCLOSURES, AND CABINETS

- 1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - a. Adalet.
 - b. Crouse-Hinds.
 - c. EGS/Appleton Electric.
 - d. Erickson Electrical Equipment Company.
 - e. FSR, Inc.
 - f. Hoffman.
 - g. Hubbell.
 - h. Kraloy.
 - i. Milbank Manufacturing Company.
 - j. MonoSystems, Inc.
 - k. Oldcastle Enclosure Solutions.
 - l. O-Z/Gedney.
 - m. Plasti-Bond.
 - n. Approved Substitution.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- I. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 4, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Fiberglass.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
- J. Cabinets:
 - 1. NEMA 250, Type 1, Type 4, Type 3R to match environment galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Metal barriers to separate wiring of different systems and voltage.
 - 4. Accessory feet where required for freestanding equipment.

PART 3 EXECUTION

3.01 RACEWAY APPLICATION

- A. Area classifications are defined on the drawings. See drawings for specific area classification requirements.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed: GRC, PVC-Coated GRC or IMC.
 - 2. Concealed in Ceilings and Interior Walls and Partitions in general purpose areas, (i.e. non-corrosive, non-classified, dry atmosphere): EMT with compression fittings.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 4. Damp, Humid or Wet Locations: GRC, PVC-Coated GRC or IMC.
 - a. GRC or IMC shall be painted with corrosive resistant paint.
 - b. Paint shall match wall color.
 - 5. Hazardous, (Class I or Class II) areas: GRC or IMC. (RAC when required by other area designations).
 - 6. Corrosive Areas: RAC, PVC-Coated GRC or Type EPC-80-PVC.
 - 7. Mildly Corrosive Areas: RAC, PVC-Coated GRC, GRC or IMC.
 - a. GRC or IMC shall be painted with corrosive resistant paint.
 - b. Paint shall match wall color.
 - 8. Boxes and Enclosures:
 - a. Indoors, dry locations: NEMA 250, Type 1 or Type 12.
 - b. Damp or wet locations: NEMA 250, Type 3R or Type 4 stainless steel.
 - c. Corrosive Areas: Type 4X stainless steel.
 - d. Hazardous, (Class I), areas: NEMA 250, Type 7.
 - e. Hazardous, (Class II), areas: NEMA 250, Type 9.
- C. Minimum Raceway Size: 3/4-inch, (21-mm), trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings. Comply with NEMA FB 2.10.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - 3. EMT: Use compression steel fittings. Comply with NEMA FB 2.10.
 - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

3.02 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- C. Do not fasten conduits onto the bottom side of a metal deck roof.
- D. Keep raceways at least 6 inches, (150 mm), away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- E. Complete raceway installation before starting conductor installation.

- F. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- G. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches, (300 mm), of changes in direction.
- H. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- I. Install conduits parallel or perpendicular to building lines.
- J. Support conduit within 12 inches, (300 mm), of enclosures to which attached.
- K. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch, (27-mm), trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot, (3-m), intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 1 inch, (25 mm), of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
- L. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- M. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- O. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch, (35mm), trade size and insulated throat metal bushings on 1-1/2-inch, (41-mm), trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- P. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- Q. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- R. Cut conduit perpendicular to the length. For conduits 2-inch, (53-mm), trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- S. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb, (90-kg), tensile strength. Leave at least 12 inches, (300 mm), of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

- U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Conduit extending from interior to exterior of building.
 - 4. Conduit extending into pressurized duct and equipment.
 - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - 6. Where otherwise required by NFPA 70.
- V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- W. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, (17 deg C), and that has straight-run length that exceeds 25 feet, (7.6 m). Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F, (55 deg C), and that has straight-run length that exceeds 100 feet, (30 m).
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F, (70 deg C), temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F, (86 deg C) temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F, (70 deg C), temperature change.
 - d. Attics: 135 deg F, (75 deg C), temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F, (0.06 mm per meter of length of straight run per deg C), of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F, (0.0115 mm per meter of length of straight run per deg C), of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches, (915 mm), of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- Y. Mount boxes at 18" or at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between boxes and cover plates or supported equipment and box.
- AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- BB. Locate boxes so that cover or plate will not span different building finishes.
- CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.03 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.04 CONDUIT PENETRATIONS IN CHEMICAL ROOM WALLS

A. Provide a conduit (LB, T, C, etc) directly on the outside of the chemical room (non-chemical space side). Fill inside of conduit with plumbers putty or silicone to stop the transference of chemical vapors.

3.05 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.06 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product

PART 2 PRODUCTS

2.01 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
- B. PVC-Pipe Sleeves: ASTM D1785, Schedule 40.
- C. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- D. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- E. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized sheet steel.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches, and with no side larger than 16 inches, (400 mm), thickness shall be 0.052 inch,
 - b. For sleeve cross-section rectangle perimeter 50 inches, or more and one or more sides larger than 16 inches, (400 mm), thickness shall be 0.138 inch.

2.02 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - 1. Eaton Link-Seal

2.03 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.04 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 EXECUTION

3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 4. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches, (50 mm), above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch, (25-mm), annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch, (25-mm), annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.02 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION

This Page Left Blank Intentionally

ELECTRIC ACTUATORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. The furnishing and installation of electric valve actuators.
 - 2. Refer to the Valve Schedule in Section 40 43 20 and the Drawings for additional instruction regarding valves which receive electric actuators.
- B. Electric Actuators shall be provided by the same supplier which provides the valves on which the actuators will be mounted.

1.02 SUBMITTALS

- A. Performance test certificate
 - 1. Each actuator must be performance tested and individual test certificates shall be supplied. The test equipment should simulate a typical valve load, and the following parameters should be recorded.
 - a. Current at maximum torque setting
 - b. Torque at maximum torque setting
 - c. Flash test voltage
 - d. Actuator output speed or operating time
 - 2. In addition, the test certificate should record details of specification such as gear ratios for both manual and automatic, and second stage gearing if provided, drive closing direction, wiring diagram number.
- B. A list of valve operating torques, including seating and unseating torques, shall be provided to Engineer with shop drawing submittal. This list shall accompany a list of actuators selected for each application and the actuators' torque capabilities.
- C. Operation and Maintenance Manuals

PART 2 PRODUCTS

2.01 GENERAL

- A. The actuators shall be suitable for use on a nominal 120 volt, single phase, 60 Hz power supply and are to incorporate motor integral reversing starter, local control facilities and terminals for remote control and indication connections housed within a self-contained, sealed enclosure.
- B. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel irrespective of the connection sequence of the power supply.
- C. In order to maintain the integrity of the enclosure, setting of the torque levels, position limits, and configuration of the indication contacts shall be carried out without the removal of any actuator covers. Commissioning tools shall be provided with the actuators and must meet the enclosure protection and certification levels of the actuators.
- D. Commissioning tools shall not form an integral part of the actuator and must be removable for secure storage/authorized release. In addition, provision shall be made for the protection of configured actuator settings by a means independent of access to the commissioning tool.

- E. Manufacturers:
 - 1. IQT Series by Rotork Controls
 - 2. Auma SQR Series
 - 3. Prior approved equal.

2.02 ACTUATOR SIZING

- A. The actuator shall be sized to guarantee valve closure at the differential pressure for each valve location. The Contractor shall be responsible for coordinating with the valve manufacturer to ensure that the actuator will be sized correctly for each valve model and size. Differential pressures for each valve shall be verified by the Contractor as necessary, and each actuator shall be adjusted to ensure correct operation under all plant conditions.
- B. It shall be the responsibility of the Contractor to verify the maximum valve operating torque for existing valves that are to be fitted with electric actuators prior to actuator selection. The actuator selected shall be capable of operating the valve in its existing condition.
- C. A list of valve operating torques, including seating and unseating torques, shall be provided to Engineer with shop drawing submittal. This list shall accompany a list of actuators selected for each application and the actuators' torque capabilities.
- D. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal.
- E. The operating speed shall be such as to give valve closing and opening at approximately 10-12 inches per minute unless otherwise determined necessary in coordination with Owner during Start-up (see Article 3.02). All actuator operating speeds shall be verified by Owner during Start-up.

2.03 ENCLOSURE

- A. Actuators shall be O-ring sealed, watertight to NEMA 4, 6/IP68 and shall at the same time have an inner watertight and dustproof O-ring seal between the terminal compartment and the internal electrical elements of the actuator.
- B. The motor and all other internal electrical elements of the actuator shall be protected from ingress of moisture and dust when the terminal cover is removed for cabling.
- C. Enclosure must allow for temporary site storage without the need for electrical supply connection.
- D. All external fasteners shall be of stainless steel, however, the use of unprotected stainless steel fasteners (including grease lubricated) in aluminum alloy casings is not permitted.

2.04 MOTOR

- A. The electric motor shall be Class F insulated, with a time rating of at least 15 minutes at 104 deg. F or twice the valve stroking time, whichever is the longer, at an average load of at least 33% of maximum valve torque.
- B. The motor shall be of the induction type, totally enclosed, non-ventilated, with cooling fans to dissipate the heat generated during operation. The motor shall be designed for severe duty.
 - 1. Modulating duty actuator motors shall be suitable for 1,200 starts per hour.
- C. Electrical and mechanical disconnection of the motor should be possible without draining the lubricant from the actuator gearcase.

2.05 MOTOR PROTECTION

- A. Protection shall be provided for the motor as follows:
 - 1. The motor shall be de-energized in the event of a stall when attempting to unseat a jammed valve.
 - 2. Motor temperature shall be sensed by a thermostat de-energizing the motor in case of overheating.
 - 3. Lost phase protection.

2.06 GEARING

- A. The actuator gearing shall be totally enclosed in an oil-filled gearcase suitable for operation at any angle. All drive gearing and components must be of metal construction and incorporate a lost-motion hammerblow feature. For rising spindle valves the output shaft shall be hollow to accept a rising stem and incorporate thrust bearings of the ball or roller type at the base of the actuator. The design should be such as to permit the opening of the gearcase for inspection or disassembled without releasing the stem thrust or taking the valve out of service.

2.07 HAND OPERATION

- A. A handwheel shall be provided for emergency operation, engaged when the motor is declutched by a lever or similar means, the drive being restored to power automatically by starting the motor. The handwheel or selection lever shall not move on restoration of motor drive. Provision shall be made for the hand/auto selection lever to be locked in both hand and auto positions. It should be possible to select hand operation while the actuator is running or start the actuator motor while the hand/auto selection lever is locked in hand without damage to the drive train.
- B. The handwheel drive must be mechanically independent of the motor drive and any handwheel gearing should be such as to permit emergency manual operation in a reasonable time. Clockwise operation of the handwheel shall give closing movement of the valve unless otherwise stated in the job specification.

2.08 DRIVE BUSHING

- A. The actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft. Normally the drive bushing shall be positioned in a detachable base of the actuator. Thrust bearings, when housed in a separate thrust base should be of the sealed for life type.

2.09 REMOTE VALVE POSITION/ACTUATOR STATUS INDICATION

- A. Limit switches shall be furnished at each end of travel and limit switch adjustment shall not be altered by manual operation. Limit switch drive shall be by counter gear. Limit switches must be capable of quick adjustment. One set of normally open and one set of normally closed contacts will be furnished at each end of travel where indicated. Contacts shall be of silver and capable of reliably switching low voltage AC/DC source from the control system furnished by others.
- B. Contacts within the actuator shall be selectable to signal the following to the WTP PLC:
 - 1. Valve opening, closing or moving
 - 2. Thermostat tripped, lost phase
 - 3. Motor tripped on torque in mid travel, motor stalled
 - 4. Remote selected
 - 5. Actuator being operated by handwheel
- C. Modulating duty actuators shall:
 - 1. Receive a 4-20 mA signal from the WTP PLC system to direct valve position.
 - 2. Output a 4-20 mA signal to be monitored by the WTP PLC system for valve position monitoring.

2.10 LOCAL POSITION INDICATION

- A. The actuator shall include a digital position indicator with a display from fully open to fully closed in 1% increments.
- B. Red, green and yellow lights corresponding to Open, Closed and Intermediate position shall be included on the indicator. End of travel indication colors shall be reversible. The digital display shall be maintained and updated during handwheel operation when all external power to the actuator is isolated. The display shall incorporate valve, actuator and control status indication. Provision shall be made to orientate the display through increments of 90°.

2.11 INTEGRAL STARTER & TRANSFORMER

- A. The reversing starter, control transformer and local controls shall be integral with the valve actuator suitably housed to prevent breathing and condensation. The starter shall be suitable for 1200 starts per hour and of rating appropriate to motor size. The controls supply transformer shall be fed from two of the incoming three phases and incorporate overload protection. It shall have the necessary tapings and be adequately rated to provide power for the following functions:
 - 1. Energization of the contactor coils.
 - 2. 24V DC output where required for remote controls.
 - 3. Supply for all the internal electrical circuits.

2.12 INTEGRAL LOCAL CONTROL AND CONTROL MODE SELECTOR

- A. The actuator shall incorporate local controls for Open, Close and Stop and a Local/Stop/Remote mode selector switch lockable in any one of the following three positions: local control only, stop (no electrical operation), remote control plus local stop only. It shall be possible to select maintained or non-maintained local control.
- B. The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.
- C. Provision shall be made to orientate the local controls through increments of 90 degrees.

2.13 HEATERS

- A. Valve actuators shall include internal heaters to minimize the formation of condensation.

2.14 CONTROL FACILITIES

- A. The necessary wiring and terminals shall be provided in the actuator for the following control functions:
 - 1. Open and close external interlocks to inhibit local and remote valve opening and/or closing control. Provision shall be made to configure the interlocks to be active in remote control only.
 - 2. Remote controls fed from an internal 24V DC supply and/or from an external supply between 20V and 120V AC or 20V and 60 V DC, to be suitable for any one or more of the following methods of control:
 - a. Open, Close and Stop control.
 - b. Open and Close maintained or "push to run" (inching) control.
 - c. Overriding Emergency Shut-down to Close (or Open) valve from a normally closed or open contact.
 - d. Two-wire control, energize to close (or open), de-energize to open (or close).
 - 3. It shall be possible to reverse valve travel without the necessity of stopping the actuator. The starter contactors shall be protected from excessive current surges during travel reversal by an automatic time delay on energization of the contactor coils.
- B. The internal circuits associated with the remote control and monitoring functions are to be designed to withstand simulated lightning impulses of up to 1.1kV.

2.15 MONITORING FACILITIES

- A. Facilities shall be provided for monitoring actuator operation and availability as follows:
 - 1. Monitor (availability) relay, having one changeover contact, the relay being energized from the control transformer only when the Local/Off/Remote selector is in the Remote position to indicate that the actuator is available for remote (control room) operation.
- B. Where required, it shall be possible to provide indication of Thermostat trip and Remote selected as discreet signals.

2.16 WIRING AND TERMINALS

- A. Internal wiring shall be tropical grade PVC insulated stranded cable of appropriate size for the control and 3-phase power. Each wire shall be clearly identified at each end.
- B. The terminals shall be embedded in a terminal block of high tracking resistance compound.
- C. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal and shall be provided with a minimum of 3 threaded cable entries with provision for a minimum of 4.
- D. All wiring supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable.
- E. A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:
 - 1. Serial number
 - 2. External voltage values
 - 3. Wiring diagram number
 - 4. Terminal layout
- F. This must be suitable for the contractor to inscribe cable core identification alongside terminal numbers.

2.17 START-UP KIT

- A. Each actuator shall be supplied with a start-up kit comprising installation instruction manual, electrical wiring diagram and cover seals to make good any site losses during the commissioning period. In addition, sufficient actuator commissioning tools shall be supplied to enable actuator set up and adjustment during valve/actuator testing and site installation commissioning.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide at least 1 day of installation supervision by the manufacturer's representative.
- B. Install equipment at the locations shown on the Drawings.
- C. Install equipment and accessories in accordance with the manufacturer's instructions.

3.02 INSPECTION START-UP & ADJUSTMENT

- A. The manufacturer or single source supplier of equipment shall inspect the completed installation, make all necessary adjustments, corrections, or modifications prior to start-up.
- B. After start-up is authorized by the Engineer, the manufacturer or supplier shall furnish a qualified representative to inspect the completed installation, to supervise the system's initial start-up, and to

train the operating personnel in the operation and equipment maintenance. At least 1 day shall be reserved for start-up and adjustment.

- C. After equipment has been placed into operation, the manufacturer's representative shall make all final adjustments for the proper operation of the equipment.
- D. Adjust valve closing and opening speeds during Start-up of each unit treatment process associated with a given valve. Valve closing and opening speeds to be determined in coordination with Engineer.
- E. Adjust actuator seating and unseating torque during Start-up to ensure effective operation of each valve.

3.03 OPERATOR TRAINING

- A. Provide a minimum of 2 hours of operator training at the Owner's convenience after equipment is operational.
- B. Training shall include a hands on segment in which the supplier reviews a test actuator (provided by Supplier for training purposes only) with the operator and demonstrates actuator operation by disassembling and reassembling actuator components.
- C. Training shall also demonstrate how to navigate through actuator programing screens to troubleshoot errors and program settings.
- D. The plant's personnel shall be sufficiently trained and thoroughly acquainted with the operations and maintenance materials to operate all components of the system.

END OF SECTION

SECTION 40 23 00

PROCESS PIPING GENERAL PROVISIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Requirements and provisions that apply to Division 40, Section 40 23 00 series relating to process piping, valves, and related accessories.
- B. Related Sections:
 - 1. Section 09 97 21 - Coating Systems for Water Treatment Facilities

1.02 REFERENCES

- A. Conform to reference standard by date of issue current on date of Contract Documents.
- B. ASTM:
 - 1. A53 - Specification for Pipe, Steel, Black and Hot Dipped Zinc Coated Welded and Seamless
 - 2. A126 - Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings
 - 3. A774 - Specification for As-welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures
 - 4. A778 - Specification for Welded, Unannealed Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures
 - 5. B62 - Specification for Composition Bronze or Ounce Metal Castings
 - 6. F439 - Specification for Socket Type Chlorinated Polyvinyl Plastic (CPVC) Pipe Fittings
 - 7. F441 - Specification for Chlorinated Polyvinyl Chloride (CPVC) Schedule 40/80 Piping
 - 8. D1785 - Specification for Polyvinyl Chloride (PVC) Schedule 04/80/120 (for Pressure Piping Applications)
 - 9. D2310 - Classification for Machine -Made Fiberglass Reinforced Thermosetting Resin Pipe
 - 10. D2464 - Specification for Threaded Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
 - 11. D2467 - Specification for Socket Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings
 - 12. D2997 - Specification for Centrifugally Cast Fiberglass Reinforced Thermosetting Resin Pipe
 - 13. D3034 - Specification for type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
 - 14. D3350 - Specification for Polyethylene Plastic Pipe and Fittings Material
- C. AWWA:
 - 1. C104 - American National Standard for Cement - Mortar Lining for Ductile Iron Pipe and Fittings for Water
 - 2. C110 - American National Standard for Ductile Iron and Gray Iron Fittings, 3-Inches Through 48-Inches for Water and Other Liquids
 - 3. C111 - American National Standard for Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
 - 4. C115 - American National Standard for Flanged Ductile Iron Pipe with Threaded Flanges
 - 5. C150 - American National Standard for Flanged Ductile Iron Pipe with Threaded Flanges
 - 6. C151 - American National Standard for Ductile Iron Pipe, Centrifugally Cast-In-Metal Molds or Sand Line Molds, for Water and Other Liquids
 - 7. C153 - American National Standard for Ductile Iron Compact Fittings for Water Service
 - 8. C200 - Standard for Steel Water Pipe 6-Inches or Larger
 - 9. C203 - Standard for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied
 - 10. C206 - Field Welding of Steel Water Pipe
 - 11. C207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4-Inches Through 144-Inches
 - 12. C500 - Standard for Gate Valves, for Water and Sewerage Systems

13. C504 - Standard for Rubber Seated Butterfly Valves
14. C508 - Standard for Swing Check Valves for Waterworks Service, 2-Inches Through 24-Inches NPS
15. C509 - Standard for Resilient-Seated Gate Valves for Water Supply Service
16. C510 - Standard for Double Check Valve Backflow Prevention Assembly
17. C512 - Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
18. C540 - Power Actuating Devices for Valves and Sluice Gates
19. C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances
20. C606 - Standard for Grooved and Shouldered Joints
21. C651 - Standard for Disinfecting Water Mains

1.03 SYSTEM DESCRIPTION

- A. The work under the Process Piping 40 23 00 series sections shall include all labor and materials required for a complete and operable process piping system. The work shall include the fabrication, installation, testing, adjusting, disinfection, start-up, and troubleshooting of the process piping system. Work shall also include the training of the Owner's designated representative in the process piping equipment and system operation and maintenance.
- B. The Contractor shall be responsible for providing a complete and fully operational process piping system as indicated on the Contract Drawings and as required by the Project Manual inclusive of all appurtenances not specifically shown or covered by the Contract Documents but required for complete operation of the process system as defined in the Contract Documents. The Contractor shall assume full responsibility for any additional costs that may result from unauthorized deviations from the Contract Documents.
- C. Refer to Section 40 23 50 for hydrostatic pressure testing.

1.04 SUBMITTALS

- A. Submit Shop Drawings for approval in accordance with Section 01 33 00 and include:
 1. Certificates of Compliance as required under Section 1.05.
 2. Fabrication and/or layout drawings:
 - a. Exterior yard piping drawings (minimum scale 1-inch equals 10-feet) with information including:
 - 1) Dimensions of piping lengths.
 - 2) Centerline elevations of piping crossings.
 - 3) Acknowledgement of bury depth requirements.
 - 4) Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, hydrants, and related appurtenances.
 - 5) Acknowledge designated valve or gate tag numbers, manhole numbers, instrument tag numbers, pipe and line numbers.
 - 6) Line slopes and vents.
 - b. Interior piping drawings (minimum scale 1/8-inch equals 1-foot) with information including:
 - 1) Dimensions of piping from column lines or wall surfaces.
 - 2) Centerline dimensions of piping.
 - 3) Centerline elevation and size of intersecting ductwork, conduit/conduit racks, or other potential interferences requiring coordination.
 - 4) Location and type of pipe supports and anchors.
 - 5) Locations of valves and valve actuator type.
 - 6) Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment, and related appurtenances.
 - 7) Acknowledgement of valve, equipment and instrument tag numbers.
 - 8) Provisions for expansion and contraction.
 - 9) Line slopes and air release vents.
 - c. Schedule of interconnections to existing piping and method of connection.

- B. If the Contractor elects to substitute products or equipment specified as “or equal” or “approved equal”:
 - 1. Contractor shall be responsible, at no additional cost to the Owner, for the following:
 - a. Space requirements.
 - b. Configuration.
 - c. Changes in connections.
 - d. Bases.
 - e. Supports.
 - f. Vibration isolation.
 - g. Structural members
 - h. Openings in structures.
 - i. Its relationship to other equipment and services that may be affected by its use.
 - 2. The Contractor shall submit scale drawings and documentation to the Engineer to show how the substituted product or equipment will be accommodated, including manufacturer’s recommended clearances and servicing provisions.
- C. Test Reports:
 - 1. Copies of pressure test results on all piping systems.
 - 2. Reports defining results of dielectric testing and corrective action taken.
 - 3. Disinfection test report.
 - 4. Notification of time and date of piping pressure tests.
- D. Operation and Maintenance Manuals: See Section 01 78 23.

1.05 QUALITY ASSURANCE

- A. The physical and chemical properties of all materials, design, performance characteristics and methods of construction and installation of all process items shall be in accordance with applicable current editions of the following standards, references, and guidelines.
 - 1. American Water Works Association (AWWA)
 - 2. American Society for Testing and Materials (ASTM)
 - 3. American Society of Mechanical Engineers (ASME)
 - 4. American National Standards Institute (ANSI)
 - 5. Occupational Safety and Health Act (OSHA)
 - 6. National Electrical Manufacturers Association (NEMA)
 - 7. Institute of Electrical and Electronic Engineers (IEEE)
 - 8. Underwriters Laboratories, Inc. (UL)
 - 9. The Chlorine Institute
 - 10. Pipe Fabrication Institute
- B. All materials, equipment and their installation shall comply with the applicable sections of the following current codes:
 - 1. Wisconsin Department of Natural Resources NR 811.
 - 2. Recommended Standards for Water Works (“10 State Standards”), Great Lakes - Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers.
- C. Provide Certificates of Compliance from the manufacturer certifying that the particular product meets the respective requirements for that item.
- D. All welding shall be performed by ASME certified welders. Submit copies of the welder’s certification to the Engineer prior to any welds made.

1.06 DELIVERY, STORAGE AND HANDLING:

- A. Inspection:
 - 1. Inspect all pipe and products as it is received to determine damage and/or missing parts.
 - 2. Notify Engineer of any missing, damaged, or defective products.
 - 3. Remove all products found to be defective by the Engineer from the site.
 - 4. Repair or replace damaged items in accordance with the manufacturer’s instructions.

- B. Handling and Storage: Handling and storage of products shall be in accordance with Section 22 of AWWA C600.

1.07 SCHEDULING

- A. The Contractor shall sequence their process work in phases as applicable to accommodate the Owner's occupancy and treatment requirements.
- B. Contractor shall submit a construction progress schedule in accordance with the requirements of Section 01 33 00. The schedule shall be a guide to construction operations and shall conform as closely as possible to the schedule.
- C. Inform the Engineer at least forty-eight (48) hours in advance of any service interruption, disruption to construction activities, or to the existing process system operation. Do not proceed until the Engineer and Owner has been fully informed and has granted their approval.

PART 2 PRODUCTS

2.01 PROCESS PIPING MATERIALS

- A. Materials used shall be in accordance to the requirements for class and size as specified or shown on the Drawings.
- B. All portions of the process piping system shall be capable of handling stresses that may occur during fabrication, installation, pressure testing and intermittent or continuous operation.

2.02 PIPE TAPS

- A. Provide the correctly sized and valved pipe taps for the installation of all facility services and process equipment apparatus and fixtures.
- B. Refer to the Drawings for locations of taps for sample lines, drains, gauges, pressure sensors, flow sensors.
- C. Review all facility services and process equipment Specifications to ensure all pipe tapping requirements are investigated and covered under this Specification Section.
- D. All blind flanges shall be tapped and fitted with a 1-inch diameter pipe nipple and ball valve.

2.03 FINISHES

- A. All piping, fittings, valves and related products and equipment shall be finished, color coded, and labeled in accordance with Section 09 97 21.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Determine locations and dimensions of existing structures, piping, and equipment associated with or potentially interfering with the proper fabrication and installation of proposed work.
 - 1. Base determination on existing records and field verification including any exploration and excavation necessary.
- B. The Contract Drawings indicate required pipe sizes, elevations, and the extent and general arrangement for process piping and equipment.
 - 1. In the event it should become necessary to change the location of any work due to interference with other work, the Contractor shall consult with the Engineer before making any changes.

2. Under no circumstances shall the pipe sizes as indicated on the Contract Drawings be changed without the written approval of the Engineer.
 3. All changes shall be made at no cost to the Owner.
- C. Prior to the fabrication or installation of any piping or equipment, consult all Drawings and construction trades to acquaint self with the materials, finishes, and locations of ceilings, structural members, pipes, ducts, lighting fixtures, conduits, etc., which may affect the installation.
 1. Coordinate work with other trades.
 2. Make modifications in layout to avoid conflict with the work of other trades and for proper execution of the work at no additional cost to Owner.
 - D. Discrepancies discovered before or after work has started, shall be immediately brought to the attention of the Engineer.
 1. The Engineer reserves the right to make minor changes to eliminate such discrepancies at no cost to the Owner.
 - E. The final length and location of required pipe connections to all process equipment shall be coordinated to meet the recommendations and requirements of the equipment manufacturer and shall be subject to approval of the Engineer.
 - F. No work shall be installed that directly connects to equipment until such time as complete Shop Drawings of said equipment have been reviewed by the Engineer.
 - G. The Contractor shall determine and be responsible for the proper locations and character of all hangers, chases, sleeves and other openings in the construction required for all process piping work.
 - H. The Contract Drawings are essentially to scale as noted. Refer to other drawings for exact locations of partitions, walls, doors, equipment, etc. Drawings shall not take precedence over field measurements.

3.02 INSTALLATION

- A. Exposed Process Piping, Valves, Supports, and Accessories
 1. Provide piping systems in accordance with the manufacturer's instructions and recommendations.
 2. Provide ductwork, piping, electrical connections, valves, and appurtenances recommended by the manufacturer for proper operation to complete the operation.
 3. Install all process piping systems to facilitate accessibility for maintenance and/or replacement.
 4. Protect all work from subsequent construction activity.
 5. Inplace components will be salvaged at the discretion of the Owner.
 - a. Remove and deliver salvaged items as directed by Owner.
 - b. Non-salvaged items will become property of the Contractor and promptly removed from the Site.

3.03 INTERIOR AND EXPOSED EXTERIOR PIPING INSTALLATION

- A. Install vertical piping runs plumb and horizontal piping runs parallel with structure walls, unless otherwise noted on the Contract Drawings.
- B. Alignment of piping smaller than 4 inches may not be shown. However, install according to Drawing intent and with clearance and allowance for:
 1. Expansion and contraction.
 2. Operation and access to equipment, doors, windows, hoists, moving equipment.
 3. Headroom and walking space for working areas and aisles.
 4. System drainage and air removal.
- C. Enter and exit through structure walls, floor and ceilings using penetrations and seals as shown on the Contract Drawings.

- D. Pipe Support:
 - 1. Use methods of piping support as shown on Drawings and as required in Section 40 23 40. The drawings are not intended to show the required pipe supports.
 - 2. Contractor is responsible for design of these support systems per Section 40 23 40.
 - 3. Size pipe supports with consideration to specific gravity of liquid being piped.
- E. Locate and size sleeves and castings required for piping system. Arrange for chases, recesses, inserts or anchors at proper elevation and location.
- F. Use reducing fittings throughout piping systems. Bushings will not be allowed unless specifically approved.
- G. Equipment Drainage and Miscellaneous Piping:
 - 1. Provide drainage for process piping at locations shown on Drawings in accordance with Drawing details.
- H. Unions:
 - 1. Install in position which will permit valve or equipment to be removed without dismantling adjacent piping.
 - 2. Mechanical type couplings may serve as unions.
 - 3. Additional flange unions are not required at flanged connections.
- I. Install expansion devices as necessary to allow expansion/contraction movement.
- J. Provide full face gaskets on all systems.
- K. Anchorage:
 - 1. Anchor or harness exposed piping subjected to forces in which joints are installed to prevent separation of joints and transmission of stress into equipment or structural components not designed to resist those stresses.
- L. Equipment Pipe Connections:
 - 1. Equipment - General:
 - a. Exercise care in bolting flanged joints so that there is no restraint on the opposite end of pipe or fitting which would prevent uniform gasket pressure at connection or would cause unnecessary stresses to be transmitted to equipment flanges.
 - b. Where push-on joints are used in conjunction with flanged joints, final positioning of push-on joints shall not be made until flange joints have been tightened without strain.
 - c. Tighten flange bolts at uniform rate which will result in uniform gasket compression over entire area of joint. Provide tightening torque in accordance with manufacturer's recommendations.
 - d. Support and match flange faces to uniform contact over their entire face area prior to installation of any bolt between the piping flange and equipment connecting flange.
 - e. Permit piping connected to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
 - f. Align, level, and wedge equipment into place during fitting and alignment of connecting piping.
 - g. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
 - h. To provide maximum flexibility and ease of alignment, assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange. Realign as necessary, install flange bolts and make equipment connection.
 - i. Provide utility connections to equipment shown on Drawings, scheduled or specified.
- M. Provide insulating components where dissimilar metals are joined together.
- N. Terminate each vent pipe with a bug screen approved by the Engineer.

3.04 FIELD QUALITY CONTROL

- A. Tests, Adjusting, and Disinfection of Process Items: See Section 40 23 50 for pressure testing, adjusting, and disinfection methods.

3.05 PROTECTION

- A. Contractor shall at all times when pipe installation is not in progress, and at times when directed by the Engineer, keep pipe and fitting openings, including manholes, tightly closed by a means acceptable to the Engineer. Closures shall be suitable to prevent entrance of animals, foreign materials, and extraneous water into the process system. Engineer may direct Contractor to secure various openings and to re-secure previously closed openings at no additional cost to the Owner.

END OF SECTION

This Page Left Blank Intentionally

SECTION 40 23 10

PROCESS WATER AND WASTE PIPING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Process water and waste piping and fitting materials.
 - 2. Installation of process piping and fittings.
- B. Related Sections:
 - 1. Section 09 97 21 - Coatings for Water Treatment Facilities
 - 2. Section 40 23 00 - Process Piping General Provisions
 - 3. Section 40 23 20 - Process Piping Valves
 - 4. Section 40 23 30 - Process Piping Specialties
 - 5. Section 40 23 40 - Process Piping Hangers and Supports
 - 6. Section 40 23 50 - Process Piping Testing, Adjusting, and Disinfection

1.02 REFERENCES

- A. ASTM:
 - 1. D1785 - Specification for PVC Pipe, Schedules 40, 80, and 120
 - 2. D2464 - Specification for Threaded PVC Pipe Fittings, Schedule 80
 - 3. D2467 - Specification for PVC Pipe Fittings, Schedule 80
 - 4. D2564 - Specification for Solvent Cements for PVC Piping Systems
- B. AWWA:
 - 1. C104 - American National Standard for Cement - Mortar Lining for Ductile Iron Pipe and Fittings for Water
 - 2. C110 - Standard for Ductile Iron and Gray Iron Fittings for Water
 - 3. C111 - Standard for Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
 - 4. C115 - Standard for Flanged Ductile Iron Pipe and Ductile Iron or Gray Iron Threaded Flanges
 - 5. C150 - Standard for Thickness Design of Ductile Iron Pipe
 - 6. C151 - Standard for Ductile Iron Pipe, Centrifugally Cast, for Water
 - 7. C153 - Standard for Ductile Iron Compact Fittings for Water Service
 - 8. C606 - Standard for Grooved and Shouldered Joints

1.03 SUBMITTALS

- A. Conform to Section 40 23 00.
- B. Submittals:
 - 1. Shop Drawings for:
 - a. Source quality control certifications.
 - b. Exterior yard pipe drawings (refer to Section 40 23 00 for drawing requirements).
 - c. Interior piping drawings (refer to Section 40 23 00 for drawing requirements).
 - d. Schedule of interconnections and detailed piping layout for connections plant piping and equipment and yard piping and method of connection.
 - 2. Operation & Maintenance Manuals
 - 3. Plan for Disinfection Procedures, Including:
 - a. Methods, locations, and sequencing for all potable water piping systems.
 - b. Scheduling and testing in compliance with AWWA requirements.
 - c. Plan for Flushing Operations, Including: Flushing water supply, flushing velocities, disposal of flushed water, and commissioning of water system.
 - d. Log of test results from an independent certified testing laboratory.

4. Plan for Hydrostatic Testing Procedures, Including:
 - a. Methods, locations, and sequencing for all required piping systems.
 - b. Scheduling and testing in compliance with AWWA requirements.
 - c. Report of test results.
5. Piping Support Plan:
 - a. Submit plan for approval prior to forming walls or slabs, including the following:
 - b. Type of support or hanger proposed at each location.
 - c. Locations and spacing for each support, embedment plate, or hanger insert.
 - d. A copy of all pipe support calculations, spacing determinations, and operating loadings prior to fabrication or installation.
6. Product Data.
7. Manufacturer's and supplier's instructions pertaining to recommended installation practice and procedures, if requested.

1.04 QUALITY ASSURANCE

- A. The materials used in this work shall be all new and conform to the requirements of this Section.
- B. For all materials specified in this Section, refer to Section 09 97 21 for requirements for surface preparation, priming, and finish coatings.

1.05 PIPING SYSTEMS

- A. Process piping shall consist of the following materials, or as shown on the Drawings:
 1. Process water piping larger than 2-1/2 inches:
 - a. Exposed: Ductile iron pipe (DIP).
 2. Process Supply Water 2-1/2 inches and smaller:
 - a. Copper pipe, Schedule 80 PVC, or as shown on the Drawings.

PART 2 PRODUCTS

2.01 DUCTILE IRON PIPING SYSTEMS

- A. Manufacturers:
 1. Pipe:
 - a. American Cast Iron Pipe Co.
 - b. U.S. Pipe.
 - c. Atlantic States Cast Iron Pipe Co.
 - d. Approved equals per Article 6.05 of the General Conditions.
 2. Fittings:
 - a. Tyler.
 - b. American Cast Iron Pipe Co.
 - c. U.S. Pipe.
 - d. Union Foundry CO.
 - e. Star Pipe Products.
 - f. Approved equals per Article 6.05 of the General Conditions.
- B. Pipe:
 1. Ductile Iron: AWWA C151.
 - a. Cement-Mortar Lining: AWWA C104.
 2. Above-Grade Interior Ductile Iron Pipe:
 - a. Conform to ANSI/AWWA C115/A21.15 for a 150 psi working pressure.
 - b. Class 53 ductile iron with ductile iron flanges.
 - c. Flanges:
 - 1) Shall be ductile iron, solid, and of the high hub design.
 - 2) Open-back flanges will not be allowed.
 - 3) "Uni-flange" or "Mega-flange" type connections are not allowed.
 - d. Outside surfaces shall be shop primed and field painted as specified in Section 09 97 21.

- C. Fittings:
 - 1. Ductile Iron: AWWA C153.
 - 2. Cement-Mortar Lining: AWWA C104.
 - 3. Joints:
 - a. Flanged: AWWA C110 or C153.
 - 4. Base Flange Support Fittings:
 - a. All base flange supported fittings shall have the base flanges faced and drilled for anchoring to concrete.
 - b. The bottom of the base flanges shall be coated with 2 coats of mastic prior to setting on concrete.
 - c. All supporting base flanges (base shoes) shall be designed to support the weight of the water-filled pipelines which apply loading to the supporting base flange.
 - 5. Blind Flanges: All blind flanges shall be tapped and fitted with a 1-inch diameter pipe nipple and ball valve.
- D. Gaskets:
 - 1. Provide rubber full face or ring gaskets capable of withstanding 250 psi hydrostatic pressures and 150 psi operating pressures.
 - 2. Approved Products/Manufacturers:
 - a. Toruseal Flange Gasket by American Cast Iron Pipe Company
 - b. Flange-Tyte Gaskets by U.S. Pipe

2.02 PVC PIPING SYSTEMS

- A. Furnish polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) pipe, fittings, and valves as shown on Drawings and/or specified herein.
- B. Use for process water, sampling water, chemical water supply lines, and chemical solution piping.
- C. Pipe:
 - 1. ASTM D1785.
 - 2. Class 12454.
 - 3. Schedule 80.
- D. Fittings:
 - 1. Schedule 80. Fittings shall be same grade, size and class of pipe.
 - 2. Threaded: ASTM D-2464
 - 3. Flanged.
 - 4. Socket: ASTM D-2467.
- E. Solvent Cement and Primer:
 - 1. Fabricate socket type connections with a solvent cement and primer conforming to ASTM D2564.
 - 2. For chemical feed lines, use the following:
 - a. Primer: Purple Weld-On P-70 or other approved equal as recommended by manufacturer for chemical service.
 - b. Solvent Cement: Gray Weld-On 724 Industrial Grade or other approved equal as recommended by manufacturer for chemical service.
- F. All valves shall be true-union style.
- G. Unions shall be installed within 2 feet of every chemical feed injection point and every connected apparatus.
- H. Carrier piping shall Sch. 80 PVC and shall be installed without fittings at joints and bends.

2.03 ANCHOR BOLTS AND NUTS

- A. Interior Fittings: Zinc coated steel.

2.04 COATINGS

- A. Interior Pipe:
 - 1. 2-component shop prime.
 - 2. Final coat per Section 09 97 21.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide piping in accordance with Section 40 23 00 and as shown on the Contract Drawings.
- B. Install vertical piping runs plumb and horizontal runs parallel with structure wall unless otherwise noted on the Drawings.
- C. Chemical feed piping horizontal runs shall be mounted 8' above finished floor elevations.
- D. Alignment for piping smaller than 4 inches may not be shown on Drawings. Install with clearance and allowance for:
 - 1. Expansion and contraction.
 - 2. Operation and access to equipment, doors, windows, hoists, and moving equipment.
 - 3. Headroom and walking space for working areas and aisles.
 - 4. System drainage and air removal.
- E. Provide full force gaskets on all systems.
- F. Fit flange joints so contact faces bear uniformly on gasket. Ensure uniform bolt stress when tightened.
- G. Bolts shall not extend more than 0.5-inch beyond the nut for all applications.
- H. Provide hangers and supports in accordance with Section 40 23 40.
- I. Perform field testing in accordance with Section 40 23 50.

END OF SECTION

SECTION 40 23 20

PROCESS PIPING VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Process piping valves and accessories.
- B. The specifications that follow are based on the performance, manufacturing and quality standard exhibited by the make and model noted. Except where noted otherwise, all valves shall conform to pertinent sections of the latest revision of AWWA C500 Specifications.
- C. Related Sections:
 - 1. Section 09 97 21 - Coatings for Water Treatment Facilities
 - 2. Section 40 05 57.23 - Electric Actuators
 - 3. Section 40 23 00 - Process Piping General Provisions
 - 4. Section 40 23 10 - Process Water and Waste Piping
 - 5. Section 40 23 40 - Process Piping Hangers and Supports
 - 6. Section 40 23 50 - Process Piping Testing, Adjusting, and Disinfection

1.02 REFERENCES

- A. AWWA:
 - 1. C504 - Rubber-Seated Butterfly Valves
 - 2. C512 - Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service

1.03 SUBMITTALS

- A. Submit in accordance with Section 01 33 00:
 - 1. Product data.
 - 2. Dimensions.
 - 3. Weight.
 - 4. Assembly drawings.
 - 5. Head loss data.
 - 6. Manufacturer recommendations for installation.
 - 7. Affidavit of Compliance per AWWA standards.
- B. Operation and Maintenance Data in accordance with Section 01 78 23.
- C. Product warranties in accordance with Section 01 78 37.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Provide valves of the same size, joint type, and body material as the corresponding piping, unless otherwise indicated.
- B. Provide valves of the same type from the same manufacturer.

2.02 BUTTERFLY VALVES (3-INCH THROUGH 24-INCH)

- A. AWWA C504.

- B. NSF/ANSI 61.
- C. Joint: Flanged, flat-faced.
- D. Class 150 B.
- E. Materials:
 - 1. Body: ASTM A126, Class B cast iron.
 - 2. Disc: ASTM A48 cast iron or ASTM A536 ductile iron.
 - a. Edge: ASTM A276, 316 stainless steel.
 - b. Offset design.
 - 3. Valve Stem: ASTM A276, Type 316 stainless steel.
 - a. Support on upper and lower nylon bearings.
 - 4. Seat: ASTM D429.
 - a. Compression – Molded in body.
 - b. Water: Acrylonitrile-Butadiene (NBR).
 - 5. Stem Seals:
 - a. Water: Acrylonitrile-Butadiene (NBR).
 - 6. Fasteners shall be 316 stainless steel.
- F. Installation Type: In-plant.
- G. Operators:
 - 1. 4-Inch and Smaller: Hand levers per this Section.
 - 2. 6-Inch and Larger: Handwheels per this Section.
 - a. Provide chain wheel with chain for installations greater than 6 feet above floor at centerline.
 - b. Maximum pull: 80 pounds at the rim.
 - c. For chainwheel operators include chain-up device by Trumbell Manufacturing or approved as equal by Engineer.
- H. Electric Actuators:
 - 1. Provide actuators as specified in Section 40 05 57.23
 - 2. Actuators compatible with the corresponding valves, and
 - 3. Have the function as collectively defined:
 - a. On the partial valve schedule,
 - b. Drawings, and
 - c. Process control descriptions.
- I. Manufacturers. All process butterfly valves throughout the facility shall be by the same manufacturer:
 - 1. DeZurik BAW
 - 2. Pratt 2FII or Triton XR-70
 - 3. Approved equal

2.03 BALL VALVES

- A. Plastic:
 - 1. Sch. 80 PVC or CPVC.
 - 2. True union.
 - 3. Seals:
 - a. Supplier shall provide seals materials as necessary for compatibility with fluid.
 - 4. Operator: Manually operated lever.
 - 5. Acceptable Manufacturers:
 - a. Chemtrol.
 - b. Spears.
 - c. George Fisher.
 - d. Asahi/America.
 - e. Approved equal.

- B. Stainless Steel:
 - 1. Comply with MSS SP-110.
 - 2. Body:
 - a. Type 316 stainless steel.
 - b. 2-piece.
 - c. Full port.
 - 3. Ball: Type 316 stainless steel.
 - 4. Seats: Teflon.
 - 5. Blow-out proof stem.
 - 6. Lever handle with balancing stops.
 - 7. Ends: FNPT x FNPT.
 - 8. Manufacturers:
 - a. Conbraco Industries (Apollo Valves).
 - b. Jamesbury.
 - c. Watts.
 - d. Nibco.
 - e. Approved equal.

2.04 VALVE TAGS

- A. Permanently attach identification tags to each valve.
- B. Tags shall display a code number corresponding to the number provided in the Drawings
- C. Tags: Engraved plastic.
 - 1. Lettering: 1/2-inch high.
 - 2. Tag Color: White.
 - 3. Lettering Color: Black.

2.05 ACCESSORIES

- A. Hand Lever Operator:
 - 1. Connect directly to shaft and parallel to disc.
 - 2. Rotate 90 degrees from full open to tight close.
 - 3. Include locking device to ensure positive disc position in the following positions:
 - a. Full open.
 - b. Full close.
 - c. Minimum of 8 positions around the quadrant of rotation.
- B. Handwheel Operators: Cast iron.
 - 1. Furnish with 2-inch AWWA nut.
 - 2. Maximum Diameter: 12 inches.
 - 3. Capable of throttling the valve in any position and holding under all operating conditions.
 - 4. Worm screw or traveling nut type.
 - 5. Totally enclosed, operating in a lubricant.
 - 6. Include exterior position indicator.

2.06 FINISHES

- A. Colors: See Section 09 97 21 for colors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect all equipment upon receipt to ensure proper function.

- B. Inspect all material and equipment as it is received to determine damage and/or missing parts. Repair or replace damaged items in accordance with manufacturers' instructions.
- C. Determine locations and dimensions of existing structures, piping, and equipment associated with or potentially interfering with the proper fabrication and installation of proposed work.
- D. Coordinate final length and location of required pipe connections to all process equipment to meet the recommendations and requirements of the equipment manufacturer subject to approval of the Engineer.
- E. No work shall be installed that directly connects to equipment until such time as complete Shop Drawings of said equipment have been reviewed by the Engineer.
- F. Determine and be responsible for the proper locations and character of all hangers, chases, sleeves and other openings in the construction required for all process piping work.
- G. Refer to other drawings for exact locations of partitions, walls, doors, equipment, etc.

3.02 FIELD QUALITY CONTROL

- A. General:
 - 1. All valves and accessories shall be installed as shown on the Drawings, as described herein, and in accordance with manufacturer's recommendations.
 - 2. Install all items in accordance with manufacturer's recommendations.
 - 3. Install items only where indicated on the Drawings.
 - 4. Installation at other location only with prior approval by the Engineer.
 - 5. All screwed or soldered piping shall have unions installed on both sides of all valves and at all connection points to all equipment.
 - 6. Install vertical piping runs plumb and horizontal runs parallel with structure wall unless otherwise noted on the Drawings.
- B. Air Release Valves and Air and Vacuum Valves:
 - 1. Ball valves shall be installed below each air valve. Inlet piping and valve shall match air valve inlet size.
 - 2. Air valves shall have downward positioned discharge pipes that terminate directly over and 18 inches above the floor drain, unless noted otherwise within the Contract Documents. Each outlet shall be covered with a 24 mesh stainless steel screen.
- C. After installation, operate each valve to ensure proper function.

3.03 PAINTING

- A. The exterior of all valves, operators, and accessories, unless otherwise described, shall be painted as specified under Section 09 97 21.
- B. Valves shall be painted to match the color of the adjacent piping.

3.04 OPERATOR TRAINING

- A. Provide minimum of 1 hour of operator training for each type of valve included in the Project.
- B. Schedule training at Owner's convenience, after system is operational. At a minimum, training topics shall include valve design, operation practices, preventative maintenance requirements, replaceable parts, and exercising schedules.

END OF SECTION

SECTION 40 23 30

PROCESS PIPING SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous process piping items.
- B. Related Sections:
 - 1. Section 09 97 21 - Coating Systems for Water Treatment Facilities
 - 2. Section 40 23 00 - Process Piping General Provisions
 - 3. Section 40 23 10 - Process Water and Waste Piping
 - 4. Section 40 23 20 - Process Valves and Accessories
 - 5. Section 40 23 40 - Process Piping Hangers and Supports

1.02 REFERENCES

- A. ASTM:
 - 1. C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
 - 2. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2005
 - 3. E96 - Standard Test Methods for Water Vapor Transmission of Materials; 2000
- B. NFPA:
 - 1. 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; 2006
- C. UL:
 - 1. 723 - Standard for Test for Surface Burning Characteristics of Building Materials, 2003

1.03 SUBMITTALS

- A. Submit Product Data which includes the following for each item furnished:
 - 1. Manufacturer and model.
 - 2. Component materials.
 - 3. Dimensions.

PART 2 PRODUCTS

2.01 PIPE COUPLINGS

- A. Sleeve type.
- B. Furnish to match pipe being coupled.
 - 1. Size.
 - 2. Material.
 - 3. Pressure.
 - 4. Service of pipe.
- C. Acceptable Manufacturers/Models:
 - 1. Dresser, Style 38.
 - 2. Smith Blair, Type 411.
 - 3. Approved equal.

2.02 RESTRAINED FLANGED ADAPTERS

- A. Furnish to match the pipe being connected:
 - 1. Size.
 - 2. Material.
 - 3. Pressure.
 - 4. Service of pipe.
- B. Acceptable Manufacturers/Models:
 - 1. EBBA Iron Series 2100 Megaflange.
 - 2. Smith Blair, Type 911.
 - 3. Romac RFCA.
 - 4. Approved equal.

2.03 WAFER STATIC MIXER

- A. Material:
 - 1. Body: Ductile iron
 - 2. Mixer Element: 316 stainless steel
- B. Size and End Connections: Flanged, match adjacent pipe.
- C. Injection Ports:
 - 1. Type: Quill
 - 2. Qty: 2
 - a. Permanganate
 - b. Chlorine
- D. Coatings as specified in Section 40 23 10 for ductile iron pipe.
- E. Acceptable Manufacturers:
 - 1. Koflow Pico Series.
 - 2. Westfall Model 2800.
 - 3. Approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Install all items in accordance with manufacturer's recommendations.
 - 2. Install items only where indicated on the Drawings.
 - 3. Installation at other location only with prior approved by the Engineer.
- B. Seals:
 - 1. Installation through fire-rated wall, floor, or roof.
 - 2. Seal annular space between piping and sleeve with approved brand fire barrier caulk or putty.

END OF SECTION

SECTION 40 23 40

PROCESS PIPING HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Supports, hangers, anchors, and guides for process piping, valves, equipment, and accessories.
- B. Related Sections:
 - 1. Section 09 97 21 - Coating Systems for Water Treatment Facilities
 - 2. Section 40 23 00 - Process Piping General Provisions
 - 3. Section 40 23 10 - Process Water and Waste Piping

1.02 REFERENCES

- A. Manufacturer's Standardization Society:
 - 1. SP-58 - Pipe Hangers and Supports - Materials, Design, and Manufacture
 - 2. SP-69 - Pipe Hangers and Supports - Selection and Application
 - 3. SP-89 - Pipe Hangers and Supports - Fabrication and Installation
- B. ANSI Code for Pressure Piping B31.1.0.

1.03 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Support piping systems in all conditions of testing and operation.
 - 2. Provide supports that will not become disengaged by movement of the supported pipes.
 - 3. Support System Factor of Safety: 3 based on supported pipe filled with water.
 - 4. Provide means of vertical adjustment after installation.
 - 5. Provide suitable linkage to permit swing at hanger locations where lateral or axial movement is anticipated.
 - 6. Do not support piping from wood or metal truss roof systems unless systems have been specifically designed for such loading.
 - 7. Size hangers to accommodate pipe covering and jacketing on insulated pipe.
 - 8. Provide support to resist flotation of empty pipe when located in submerged areas.
- B. Performance Requirements:
 - 1. Support systems shall prevent movement of the piping in any direction due to pressure, temperature, flow, or water hammer except at properly located expansion joints and fittings.
 - 2. Support piping in a manner to prevent undue strain on equipment, valves, and fittings.

1.04 SUBMITTALS

- A. Provide manufacturer's Product Data for all proposed hangers and supports.
- B. Provide Shop Drawings for all specially designed hanger assemblies and fabrications.
- C. Provide calculations indicating the load at each support location.
- D. Provide Shop Drawings indicating the proposed device at each support location.

1.05 QUALITY ASSURANCE

- A. Conform to ANSI B31.1.1.0 except where modified by the Contract Documents.

1.06 SEQUENCING AND SCHEDULING

- A. Proceed with the installation of support equipment only after the respective building structural work has been completed and approved and any associated concrete support structure has reached its 28-day compressive strength.

PART 2 PRODUCTS

2.01 GENERAL

- A. Support process piping from structural elements with adjustable hangers.
- B. Hanger Rods: Subject to tensile loading only.
- C. Pipe hangers and supports shall be fabricated from:
 - 1. Galvanized steel, hot-dipped after fabrication.
 - 2. 304 stainless steel.

2.02 MANUFACTURED UNITS

- A. Provide the units indicated for the following applications:
 - 1. Hangers for Ductile Iron, Steel, or Plastic Piping 3 Inches and Larger.
 - a. Anvil Figures 45, 104, 171, and 260.
 - b. Equivalent units by:
 - 1) Cooper.
 - 2) PHD.
 - 2. Adjustable Pipe Saddle Supports for Process Piping on Structural Slabs for Ductile Iron, Steel, or Plastic Piping 3 Inches and Larger:
 - a. Anvil Figures 259, 264, and 265.
 - b. Equivalent units by:
 - 1) Copper.
 - 2) PHD.
 - 3. Hangers From New Reinforced Concrete:
 - a. Loadings Under 400 Pounds:
 - 1) Anvil Figure 285.
 - 2) Equivalent units by:
 - a) Cooper.
 - b) PHD.
 - b. Loadings of 400 Pounds to 1,140 Pounds:
 - 1) Universal concrete inserts.
 - 2) Anvil Figure 282.
 - 3) Equivalent units by:
 - a) Cooper.
 - b) PHD.
 - 4. Continuous Slot Inserts:
 - a. Unistrut P3200 Series.
 - b. Power-strut PS-349 Series.
 - c. Halfen Channels 4122 or 4141 Series.
 - d. Inserts shall have working load capacities greater than the pipe hanger loadings.

2.03 ACCESSORIES

- A. Anchor Bolts: ASTM A307, Grade A.
 - 1. Standard threads and hexagonal nuts.
 - 2. Galvanized or cadmium plated.
 - 3. Bolts in Submerged or Exterior Applications: Stainless steel.

- B. Expansion Bolt Anchors:
 - 1. Subject to approval of the Engineer.
 - 2. Anchors in Submerged or Exterior Applications: Stainless steel.

PART 3 EXECUTION

3.01 GENERAL

- A. Install all units in accordance with manufacturer's instructions.
- B. Locate units so that finished piping will not interfere with:
 - 1. Open accesses.
 - 2. Walkways and platforms.
 - 3. Future maintenance of equipment.
- C. Group parallel runs of horizontal piping together on trapeze-type hangers where possible.
- D. Install supports to provide specified slope when indicated.
- E. Provide units of the same type and style for adjacent similar piping.
- F. Installation in steel framed structures.
 - 1. Support piping from beam clamps, attachments, or brackets bolted to steel joists or beams.
 - 2. Verify with Engineer that structural components are capable of carrying the intended load and stresses.
 - 3. Not permitted.
 - a. Holes drilled in building steel for hanger support rods.
 - b. Bolting to decking or walkways.
- G. Do not install support attachments for loadings over 50 pounds to the underside of hollow core precast planks without the specified approval of the Engineer and precast plank supplier.
- H. Install supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors.
- I. Install supports to facilitate the movement of expansion joints, loops, bends, and similar items.
- J. Approximate support locations are shown on the Drawings for pipes 12 inches and larger. Provide additional supports as required to meet the specific provisions of this section.

3.02 INSTALLATION

- A. Pipe Support Spacing:
 - 1. Locate units and accessories in accordance with minimum defined in MSS SP-58 and 69.
 - 2. Provide a minimum of 1 support for each length of pipe and at each change of direction or elevation.
 - 3. Provide additional supports within 3 feet of each joint for every valve, fitting, flow meter, flexible coupling, and all non-rigid joints.
 - 4. Locate supports in accordance with maximum allowable spacing shown on the schedules at the end of this section.
- B. Building Attachments:
 - 1. Support pipe hangers from concrete inserts in reinforced concrete structures as follows:
 - a. Where support rod sizes exceed 7/8-inch in diameter, or where the pipe load exceeds the recommended load for the insert, use 2 inserts with a trapeze-type connecting member below the concrete.
 - b. Submit proposed insert locations to Engineer for approval in a timely manner to provide for placement of concrete.

- c. Provide reinforcing rods for pipe sizes over 3 inches.
 - d. In areas where the concrete slab will form the finished ceiling, ensure that inserts finish flush with slab surface to make a neat appearance.
 - e. Locate concrete inserts so that total load on insert does not exceed manufacturer's recommended maximum load.
 - 2. Locate attachments to ensure that the total and point loads from the supports do not exceed the design capacity of the supporting structure.
 - 3. Where it is necessary to anchor supports to hardened concrete or completed masonry, use either:
 - a. Epoxy type adhesive anchors.
 - b. Expansion type anchors.
 - 4. For precast concrete plank, drill through concrete plank from below and provide through bolts with square steel plate and nuts.
 - a. Plate shall bear directly upon the top surface of the precast concrete plank.
 - b. Apply all toppings and insulations after installation of support plate assembly.
 - 5. Attach to structural steel members with beam clamps.
 - 6. Do not support piping from other piping.
 - 7. Prevent contact between dissimilar metals.
 - a. Where a concrete or metal pipe support is used, place a 1/8-inch-thick Teflon, neoprene rubber, or plastic strip under piping at point of bearing.
 - b. Cut to fit entire area of contact between pipe and support.
 - 8. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, plastic coated, or by other recognized industry methods.
 - a. Electrician's tape is **not** an acceptable isolation method.
- C. Hanger Supports:
- 1. Adequate to maintain pipe, apparatus, and equipment in proper position and alignment under all operating conditions.
 - 2. Screw adjustable after installation is complete.
 - 3. Provide piping supported from the ceiling with adjustable wrought clevis hangers.
 - 4. All steel work, bolts, nuts, washers, and welding shall conform to the applicable provisions of Division 5.
 - 5. Hanger rods shall be attached to inserts in new concrete slabs.
 - 6. Install individual or continuous slot concrete inserts for use with hangers for piping in the formwork before concrete slabs are poured.
 - a. Furnish inserts with end caps and cardboard closure strips or filled with foam to prevent concrete intrusion.
 - b. Provide all clamping nuts with springs, additional supporting steel and hanger rods required to make the complete installation.
 - c. Concrete inserts shall be hot-dip galvanized after being cut to the necessary lengths and installation of end plates.
 - d. Clamping nuts shall be given an electro-galvanized finish.
 - 7. Where 2 or more horizontal pipes 3-inches or smaller are run on close centers, support on trapeze-type hangers.
 - a. Use Unistrut P1000, Power-Strut, or equal.
 - b. The maximum load per trapeze shall be 200 pounds calculated with all pipes full of water and the maximum length shall be 36 inches.
 - c. Minimum rod size shall be 3/8-inch.
 - 8. Use wall brackets for wall-mounted pipe 2 inches and smaller.
 - 9. Provide pipe guides for hanger supported pipe.
 - a. Install guide on each hanger.
 - b. Install at 60-foot centers and no more than 60 feet from an anchor.
- D. Thrust Anchors and Guides:
- 1. Suspended Piping:
 - a. Center thrust anchors between expansion joints and/or elbows.
 - b. Anchors shall hold pipe securely.
 - 1) Allow for movement at expansion joints.
 - 2) Prevent separation of joints.

2. Provide thrust anchors as follows:
 - a. Changes in pipe diameter.
 - b. Changes in pipe direction.
 - c. Pipe dead ends.
3. Provide anchorage whenever bending stress exceed the allowable stress of the pipe.
4. Wall pipes may be used as thrust anchors.
5. Provide pipe guides adjacent to sliding expansion joints in accordance with the National Association of Expansion Joint Manufacturers.

3.03 SCHEDULES

- A. Maximum allowable spacing of pipe supports:

1. Ductile Iron Pipe:

Pipe Size-Inches	Max. Span Feet
4 and less	6
6 thru 12	8
14 and greater	16

END OF SECTION

This Page Left Blank Intentionally

SECTION 40 23 50

PROCESS PIPING TESTING, ADJUSTING, AND DISINFECTION

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Hydrostatic leak testing.
 - 2. Process equipment testing and adjusting.
 - 3. Process system disinfection.
- B. Related Sections:
 - 1. Section 40 23 00 - Process Piping General Provisions
 - 2. Section 40 23 10 - Process Piping Water and Waste Piping

1.02 REFERENCES

- A. AWWA:
 - 1. C651 - Disinfecting Water Mains
 - 2. C653 - Disinfection of Water Treatment Plants

1.03 SUBMITTALS

- A. Submit copies of the following test results:
 - 1. Field quality control.
 - 2. Start-up.
 - 3. Disinfection.

1.04 SCHEDULING AND SEQUENCING

- A. Perform leakage testing prior to the application of coatings or insulation on the piping.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 PREPARATION

- A. Isolate all piping and equipment from potable water systems.
- B. Remove foreign materials from the piping and equipment by means of flushing or other appropriate methods.
- C. Install taps in pipe as required to expel air prior to hydrostatic testing.

3.02 FIELD QUALITY CONTROL

- A. Leak Testing:
 - 1. All process piping shall be pressure tested prior to insulation and/or painting.
 - 2. Process piping shall be tested to a hydrostatic pressure of 150 pounds per square inch, unless otherwise noted in Section 40 23 00. After bringing the system to the required pressure, it shall be

- left for at least one hour and shown no loss in pressure due to leakage. If leakage is detected, the cause shall be determined and corrected, and the test shall be conducted again until satisfactory results are obtained at the expense of the Contractor.
3. Install all necessary taps in pipe to fill with water and to expel air prior to hydrostatic test and plug as approved by Engineer.

3.03 ADJUSTING

- A. Contractor shall provide an authorized and qualified representative to inspect, calibrate, and adjust process equipment and systems prior to start-up and to supervise placing of equipment and systems in operation. Representative shall be available for troubleshooting and adjustment of equipment and systems to insure a fully functional and operable process system.

3.04 DISINFECTION

- A. Disinfection is required of all potable lines and equipment installed or modified under this Contract before being placed or returned to service. Lines and equipment must be isolated from the active distribution system until bacteriological tests are satisfactorily completed. Disinfect in accordance with AWWA-C651 and AWWA-C653, and the rules and regulations of the Minnesota Department of Health.
- B. Remove, by flushing or other means, those materials that may have entered the water lines.
- C. Provide a free chlorine dosage of 50 parts per million for a 24-hour minimum exposure.
- D. Operate all valves or other appurtenances during disinfection period.
- E. Determine the bacteriological quality by laboratory testing after disinfection. All samples shall be tested in accordance with *Standard Methods for the Examination of Water and Wastewater*, and shall show the absence of coliform organisms.
- F. Flush all treated water thoroughly following disinfection until replacement water throughout shall, upon testing, prove chemically and biologically equal to the water from the potable water supply.
- G. If the initial disinfection fails to produce satisfactory bacteriological results, the line may be reflushed and shall be resampled. If check sample also fails to produce acceptable results, the line shall be rechlorinated until satisfactory results are obtained.
- H. When satisfactory test results are achieved, the water line may be connected to the active water distribution system.

END OF SECTION

SECTION 40 90 00
CONTROL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Installation, Identification, Testing and Commissioning
- B. Control system functional descriptions

1.02 RELATED SECTIONS

- A. Section 40 05 57.23 - Electric Actuators
- B. Section 40 23 20 - Process Piping Valves
- C. Section 40 91 19 – Instrumentation
- D. Section 43 22 52 – Magnetic Flowmeters

1.03 REFERENCES

- A. National Fire Protection Association (NFPA), latest adopted version.
- B. National Electrical Manufacturers Association (NEMA)
 - 1. NEMA ICS-2 Industrial Control Devices, Controllers, and Assemblies.
 - 2. NEMA 250 Enclosures for Electrical Equipment.
- C. Underwriters Laboratories (UL)
 - 1. UL 508 Industrial Control Equipment.
 - 2. UL 698A Industrial Control panels for Hazardous Locations.
 - 3. UL 913 Intrinsically-safe Apparatus and associated apparatus for use in Class I, II and III, Division 1, Hazardous Locations.

1.01 SCOPE

- D. Contractor shall add or re-add in the new and relocated instrumentations/devices into the WTP SCADA.
- E. It is the intent of the Contract Documents that all equipment specified in this Section of the specifications be supplied by a single-source supplier ("Systems Integrator"). The supplier shall assume full responsibility along with the Contractor for furnishing, installing and start-up procedures so as to make the system operate per the intent of the Contract Documents.
- F. The work specified in this Section includes furnishing, installing, start-up, testing, and adjusting of all required equipment, including instruments, equipment, hardware, software, wiring, accessory equipment, and training to provide a completely operational process instrumentation and control system.
- G. It shall be the responsibility of the Contractor and supplier to examine all new and existing equipment that is transmitting a signal to, or receiving a signal from, equipment specified in this Section. The Contractor shall be responsible for providing signal converters, buffer amplifiers, and isolation devices to make signal levels, reference to ground, etc. compatible between devices specified in this Section and existing equipment or equipment specified in other Sections.

- H. The labor specified herein includes but is not limited to engineering software development, panel fabrication, equipment calibration and adjustment, testing, training, and documentation.
- I. This section includes coordination with the work of other sections and requires identification of exact interface requirements with motor and control devices provided under other portions of this specification. It shall be the responsibility of the Systems Integrator specified under this section to execute this coordination during the shop drawing submittal phase of the work.
- J. This section includes coordination with electrical contractor to ensure that the proper number and type of conductors are installed. It shall be the responsibility of the Systems Integrator to coordinate this work with the installing electrician.

1.04 SUBMITTALS

- A. Technical data in conformance with Division 1 and including:
 - 1. All equipment and components indicated on the Drawings and specified in Part 2 of this Section.
 - 2. Software packages including complete description of features and capabilities.
- B. Shop Drawings in conformance with Division 1 and including:
 - 1. Panel Drawings including system schematic drawings, terminal numbering, wire numbering, component schematic drawings, dimension drawings, layout drawings and nameplate schedule.
 - a. Panel exterior general arrangement drawings showing location of surface and flushed mounted equipment.
 - b. Panel interior arrangement drawings including:
 - 1) Locations and identification of terminal blocks.
 - 2) Locations and identification of racks/chassis and equipment mounted within.
 - 3) Arrangement of other equipment mounted inside panel identified by instrument tag number.
 - c. Exterior panel wiring interface termination diagrams.
 - 2. Complete new drawings for all existing panels that are modified under this Contract. Re-draw existing circuitry based on field investigation by Systems Integrator. Drawings shall include all existing components and circuitry, and shall include all proposed components and circuitry.
 - 3. Overall system diagram showing all components, converters, cables, and connectors.
 - 4. Proposed computer and operator interface unit graphic displays. Submit "rough" or hand-drawn copies prior to programming for approval.
- C. Operational and Maintenance data in conformance with Division 1 and including:
 - 1. Panel equipment, field devices and instruments, including "as-built" system schematics.
 - 2. Final copy of PLC program on 8 1/2" x 11" sheet in ladder format. Include verbal description of each rung's function.
 - 3. Thumb drive containing final PLC program, final operator interface application files and final distributed control software application files.
 - 4. Thumb drive containing final system record drawings, wiring diagrams and panel details. The drawings files shall be in AutoCAD format (.DWG files).
 - 5. Complete software documentation including programming information and operator's guides. Include hard copies of all operator interface unit and computer graphic screens.
 - 6. Point list of all PLC inputs/outputs. Identify point number (tag), point description, point type, range in engineering units (if analog point), PLC number, rack and slot number, and point address.
- D. Start-up report from system supplier per requirements of Division 1.
- E. Spare Equipment Lists- Provide a list of recommended spare parts and equipment that is considered spare parts and equipment that is considered crucial to the operation of the system.
- F. All submittals shall be bound in 3-ring binders with labeled tabs separating sections.

1.05 TESTING AGENCY CERTIFICATION

- A. All new panels and subpanels furnished under this Section shall be constructed in accordance with Underwriter's Laboratories (UL) Standard 508- "Industrial Control Equipment", and applicable portions of UL standards 698A – "Industrial Control Panels for Hazardous Locations" and UL Standard 913 – "Intrinsically-Safe Apparatus and Associated Apparatus for use in Class I, II and III, Division 1, Hazardous Locations".

1.06 QUALITY ASSURANCE

- A. All materials, equipment, and parts shall be new and unused of current manufacture.
- B. System Integrator shall be responsible for providing all necessary accessories required for a complete and operational system.
- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- D. Products: Listed and classified by UL or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 INTEGRATOR

- A. Systems integrator shall be the following:
 - 1. Total Control Systems Inc.
 - a. Phone: 320-396-4442

PART 3 EXECUTION

3.01 LABELING

- A. Label all field mounted control devices, instrumentation, switches, etc., with tag number and item description.
- B. Labels shall be engraved laminated plastic with ¼" high lettering. Labels shall be attached with stainless steel screws to the device or nearby wall.

3.02 CALIBRATION, ADJUSTING AND TESTING

- A. Devices requiring field calibration shall be calibrated in the presence of the Engineer's representative and documented.

3.03 PROJECT MANAGEMENT

- A. Supplier shall provide engineering and administrative services necessary to fulfill the requirements of this specification.
- B. Supplier shall provide the services of an experienced project manager as the overall coordinator during the course of the project.

3.04 PROGRAMMING SERVICES

- A. Program the programmable logic controllers (PLCs) and computer as required by the functional descriptions.

- B. Provide additional programming during start-up, training, and call-back periods as specified.

3.05 INSTALLATION AND START-UP

- A. Supplier shall provide a skilled programmer/instrumentation engineer or technician who shall complete troubleshooting and start-up to place the entire system into satisfactory operation. The engineer or technician shall make the necessary inspection of the completed installation, make the necessary final field adjustments, and make program revisions are required for start-up.
- B. Conduct a 4 hour demonstration of all system features and functions to Owner and Engineer.
- C. Coordinate installation and start-up scheduling with Owner and Engineer.

3.06 ACCEPTANCE TESTING

- A. On-Site Testing and Commissioning:
 - 1. Provide services of a systems integrator technician to checkout, test, and commission the system at the Project Site.
 - 2. Place equipment into service and provide operation as specified.
 - 3. Provide actual activation of each control function and alarm in the system. If actual activation is not possible, the function shall be simulated.
 - 4. Record all Changes in the Control Systems:
 - a. Revise all wiring diagrams and schematic diagrams to show final installation.
 - b. Insert revised diagrams into each operation and maintenance manual in place of original diagrams
- B. After the installation is complete, and proper operation has been demonstrated, a 60-day acceptance test shall begin. The entire system shall be required to operate for 60 days with no malfunctions, field repairable malfunctions excepted. Any malfunction during the 60-day test which cannot be corrected within 24 hours by the supplier shall be considered a non-field repairable malfunction and after repairs are complete, the test shall be repeated.
- C. The acceptance test shall apply to all equipment furnished under this Section.

3.07 ON-SITE SERVICES

- A. In addition to other services specified, provide a competent programmer/instrumentation engineer or technician to perform the following services:
 - 1. Software revisions – Five (5), eight (8) hour days on-site to make software revisions per Owner and Engineer direction, and to coordinate with filter manufacturer for filter system controls.
 - 2. Training – 8-hours on –site to train Owner's personnel on:
 - a. Operation and maintenance of all equipment furnished.
 - b. Training shall be a maximum of 4-hours in a given day.
 - c. Computer software operation and programming including building reports, building graphics and modifying tags and database.
 - d. Training shall not include travel time to the site.
- B. All on-site services shall be at times approved by Owner.
- C. At project completion, supplier shall certify in Writing that all un-used service hours will be provided at Owner's request during the first three years of operation. The remaining service hours shall be fulfilled by either a software engineer or field service technician as required by the task required by the Owner.

3.08 CALL-BACK SERVICES

- A. In addition to other services specified, provide a competent programmer/instrumentation engineer or technician to return to the project site for two (2), non-consecutive eight (8) hour days during the first year of operations. During each trip, the supplier's representative shall be prepared to calibrate and check equipment furnished under this contract, give miscellaneous training, and make software revisions.

- B. Call-back trips shall be at times determined by the Owner.

3.09 SUPPLIES

- A. Contractor shall provide all expendable items such as lamps, fuses, etc. For system startup, checkout, and during the acceptance test.
- B. At Final Completion, Contractor shall furnish the following expendable items:
 - 1. Twenty (20) percent spare fuses and lamps of each type furnished, but not less than six (6) of each type.

3.10 SPARE PARTS

- A. Contractor shall furnish the following spare parts to the Owner. Spares shall be delivered in boxes labeled on the outside with manufacturer and part number identified on the box:
 - 1. One (1) spare relay for each type of relay used.
 - 2. Two (2) fuses of each type used.
 - 3. One (1) spare power supply of each type used,
- B. Provide the following special tools:
 - 1. Mounting ring wrench(s) for pushbuttons, switches, and lights.
 - 2. Fuse puller.

3.11 MAINTAINING AUTOMATIC CONTROLS DURING CONSTRUCTION

- A. Contractor shall coordinate construction activities to keep the existing plant instrumentation and controls system operational throughout the course of the project. Contractor shall furnish and install temporary controls and wiring as required to maintain automatic operation, and shall remove such temporary controls and wiring once permanent controls and wiring are operational and accepted.
- B. When existing panel or instruments are modified or replaced under this Contract, Contractor shall schedule the work in advance with Owner and Engineer, and shall perform the Work so as to minimize the impact on Owner's operation of the facility. Controls shall only be removed from automatic operation during normal working hours, Monday through Friday.
- C. For scheduled outages or cutovers, once the control system revisions begin, Contractor shall work continuously until automatic operation is restored.

APPENDIX A

FUNCTIONAL DESCRIPTIONS

GENERAL SOFTWARE AND PROGRAMMING FEATURES

- A. System Communications
 - 1. Provide Ethernet TCP/IP communications between PLC panel and devices located in building as indicated on the plans.
 - 2. Alarm if communication is lost with any panel or device on the network(s). Generate a descriptive alarm condition that identifies the sites where communication has been lost.
- B. Analog Value Alarms
 - 1. Allow operator to assign "high" and "low" software setpoints to all analog inputs. If measured value exceeds the high setpoint or falls below the low setpoint, energize an associated alarm at the computer. All displays and software setpoints shall be in engineering units.
 - 2. Analog value alarms shall function as described elsewhere for plant alarms.
- C. Equipment "Fail" Alarms
 - 1. When an equipment item is called to operate, monitor the associated RUNNING contacts. If a RUNNING signal is not returned after five seconds (adjustable), then generate a descriptive alarm point.
- D. Miscellaneous Status and Alarm Points
 - 1. The Drawings show several miscellaneous status and alarm points that are not specifically described in these functional descriptions. Graphic screens shall be provided to include all of the status information that is available at the PLCs. Alarms shall be developed for each of the alarm points that are available.
- E. Software Control Switch
 - 1. Each piece of equipment controlled via the PLC shall have a software Hand-Off-Auto switch. In the Hand mode, the equipment shall be called to operate. In the Auto mode, the piece of equipment shall be called to operate as described herein. In the Off mode, the equipment shall be de-energized and will not operate regardless of the controlling value status. If the equipment should be called to operate based on the controlling logic described, but the equipment is in the Off mode, generate an associated alarm.
 - 2. Provide a computer screen to show the status of the software HOA switch for each piece of equipment.
- F. Hardware Control Switch
 - 1. The Drawings indicate hardware Hand-Off-Auto selector switches and other equipment having IN AUTO signals to the plant control system. If the equipment should be called to operate based on the controlling logic described, but the switch (or signal from equipment) is not in the AUTO position, generate an associated alarm.
 - 2. Monitor local HOA control switches for each piece of equipment and display IN AUTO on the computer screens. When in AUTO mode, call for a piece of equipment to operate as required to satisfy its control signal.
- G. Software Run Time Meters
 - 1. Each piece of equipment with a "Running" contact monitored by the PLC shall have a software Run Time Meter (RTM).
 - 2. Software RTM shall monitor the RUNNING contact and the computers shall display totalized, non-resettable run time in hours and tenths, and runtime for the last 24 hours in hours and tenths.
- H. Flow metering
 - 1. Each flowmeter system will include a 4-20 mAdc analog output signal for use by the control system for remote monitoring of flow. The 4-20 mAdc flow signal will be linear with flow. Confirm flow ranges for the flow meters with the Owner and Engineer during construction. Input the 4-20 mAdc flow signal to the PLC. Transmit the instantaneous signal to the computers for display on the HMI screens.
 - 2. PLC shall totalize flow by monitoring the 4-20 mAdc output signal from each meter and shall make the information available on the computer screens.
 - 3. Allow the operator to choose to trend on each flow signal.
 - 4. Provide computer screens with the following:
 - a. Display of all instantaneous flows (GPM).
 - b. Display of daily totalized flows (thousands of gallons).

- I. Valves/Gates
 1. Upon sending an OPEN or CLOSE command, the PLC shall monitor the limit switches to verify proper operation. If after 30 seconds (adjustable) the valve/gate has not properly responded, generate an alarm.
 2. Upon sending a position signal for modulating valves, the PLC shall monitor the feedback signal to verify proper operation. If after 30 seconds (adjustable) the valve has not properly responded within an adjustable deadband, generate an alarm. Display valve position.
- J. Managed Ethernet/Fiber Ring Switches in Control Panels
 1. Monitor the output contract (alarm or OK) as provided with the switches supplied at the PLC and generate the associated alarm.

FUNCTIONAL DESCRIPTIONS

- A. Relocated Flow Meter RAW-FIT-2
 1. Operate as prior to relocation. (No change to function).
- B. Chlorinator
 1. The gas chlorination feed system shall be modified to include an automatic chlorinator for Well 8 and Well 9 production. The chlorinator shall operate as follows.
 2. The existing solenoid valves shall open to provide water at distribution system pressure when the filters are producing water. (No change to function.)
 3. The chlorination system shall become operational and feed chlorine when the Well 8 and/or the Well 9 pump(s) are running. (Addition of Well 8 to existing function).
 4. The SCADA system shall provide a signal to stop and start the chlorinator output. (New function.)
 5. The chlorinator shall run at the following setpoints: (New function.)
 - a. Well 8 and Well 9 Off: There shall be no flow of chlorine.
 - b. Well 8 and Well 9 Running: Operator adjustable setpoint of chlorine feed rate (Setpoint 1).
 - c. Well 8 Off, Well 9 Running: Operator adjustable setpoint of chlorine feed rate (Setpoint 2).
 - d. Well 8 Running, Well 9 Off: Operator adjustable setpoint of chlorine feed rate (Setpoint 3).
- C. Filters
 1. Filter 1:
 - a. Devices: Modulating Valve MV-FW-1, Flow Meter FIT-F1 & FE-F1
 - b. Modes:
 - 1) Well 7, 8, and 9 Off: MV-FW-1 is closed.
 - 2) Filtration Mode: MV-FW-1 is normally open to the 90% position. Upon measurement of flow by FE-F1, MV-FW-1 shall remain in the open position.
 - 3) Open position during filtration mode to be operator adjustable.
 - 4) Backwash Mode of Filter 1: MV-FW-1 is open.
 2. Filter 2:
 - a. Devices: Modulating Valve MV-FW-2, Flow Meter FIT-F2 & FE-F2
 - b. Modes:
 - 1) Well 7, 8, and 9 Off: MV-FW-2 is closed.
 - 2) Filtration Mode:
 - a) MV-FW-2 is normally open to the 90% position. Upon measurement of flow by FE-F2, MV-FW-2 shall remain in the open position.
 - b) Flow Balancing:
 - (1) Flow of FE-1 and FE-2 shall be monitored. In the event that the flow value from FE-2 is greater than FE-1, MV-FW-2 shall be modulated to be more closed until the flow value between FE-1 and FE-2 is equivalent.
 - (2) Flow of FE-1 and FE-2 shall be monitored. In the event that the flow value from FE-2 is less than FE-1, MV-FW-2 shall be modulated to be more open until the flow value between FE-1 and FE-2 is equivalent.
 - c. Backwash Mode of Filter 2: MV-FW-2 is open.

END OF SECTION

SECTION 40 91 19

INSTRUMENTATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Instrumentation:
 - 1. Actuator – Valve (Electric)
 - 2. Flowmeter – Magnetic
- B. Testing and Commissioning
- C. Installation
- D. Instrumentation List

1.02 RELATED SECTIONS

- A. 40 05 57.23 Electric Actuators
- B. 40 23 20 Process Piping Valves
- C. 43 22 52 Magnetic Flow Meters
- D. 46 31 11 Gas Chlorine Feed Equipment

1.03 REFERENCES

- A. National Fire Protection Association (NFPA), latest adopted version.
- B. National Electrical Manufacturers Association (NEMA)
 - 1. NEMA ICS-2 Industrial Control Devices, Controllers, and Assemblies.
 - 2. NEMA 250 Enclosures for Electrical Equipment.
- C. Underwriters Laboratories (UL)
 - 1. UL 508 Industrial Control Equipment.
 - 2. UL 698A Industrial Control panels for Hazardous Locations.
 - 3. UL 913 Intrinsically-safe Apparatus and associated apparatus for use in Class I, II and III, Division 1, Hazardous Locations.

1.04 GENERAL

- A. The work specified in this Section includes furnishing, installing, start-up, testing, and adjusting of all required equipment, including instruments, equipment, hardware, software, wiring, accessory equipment, and training to provide a completely operational process instrumentation and control system.
- B. It shall be the responsibility of the Contractor to furnish a complete and fully operating system. The Contractor shall be responsible for all details which may be necessary to properly install, adjust and place in operation the complete installation. The contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the Contract Documents.
- C. It shall be the responsibility of the Contractor and supplier to examine all new and existing equipment that is transmitting a signal to, or receiving a signal from, equipment specified in this Section. The Contractor shall be responsible for providing signal converters, buffer amplifiers, and isolation devices

to make signal levels, reference to ground, etc. compatible between devices specified in this Section and existing equipment or equipment specified in other Sections.

- D. The Contractor shall be responsible for selecting instrumentation models to have the proper range values for the system it is connected to and measuring.

1.05 SUBMITTALS

- A. Technical data in conformance with Division 1 and including:
 - 1. All equipment and components indicated on the Drawings and specified in Part 2 of this Section.
- B. Shop Drawings in conformance with Division 1 and including:
 - 1. Manufacturer's data or specification sheets for instrumentation and control devices showing design parameters, equipment catalog designations, calibration range, and clearly identifying options provided.
 - 2. Certified outline drawings
 - 3. Installation drawings including mounting and grounding requirements.
 - 4. Wiring connection drawings for equipment and accessories provided. Wiring interconnection drawings shall define terminal numbers and functions for interface with other instruments and equipment.
- C. Operational and Maintenance data in conformance with Division 1 and including:
 - 1. Field devices and instruments, including "as-build" system schematics.
 - 2. Provide hard copies as required in Division 1.
- D. Start-up report from system supplier per requirements of Division 1.
- E. Spare Equipment Lists- Provide a list of recommended spare parts and equipment that is considered spare parts and equipment that is considered crucial to the operation of the system. Include list of parts for each item.

PART 2 PRODUCTS

2.01 INTEGRATOR

- A. System integrator shall be Total Control Systems, Al Doberstein, 320.396.4442

2.02 ACTUATOR – VALVE (ELECTRIC)

- A. See Section 40 05 57.27.

2.03 FLOWMETER - MAGNETIC

- A. See Section 43 22 52 Magnetic Flowmeters.

PART 3 EXECUTION

3.01 LABELING

- A. Label all field mounted control devices, instrumentation, switches, etc., with tag number and item description.
- B. Labels shall be engraved laminated plastic with ¼" high lettering. Labels shall be attached with stainless steel screws to the device or nearby wall.

3.02 CALIBRATION, ADJUSTING AND TESTING

- A. Devices requiring field calibration shall be calibrated in the presence of the Engineer's representative and documented.

3.03 INSTALLATION AND START-UP

- A. Control devices shall be provided and wired as shown on the Drawings. Control schematics and wiring connections shown on the Drawings are based upon the equipment specified and the typical wiring diagrams furnished by the manufacturer. The Contractor shall review the wiring diagrams for the equipment actually furnished and modify the wiring shown on the Drawings to conform to the requirements of the equipment furnished. The Contractor will not be compensated for extra labor and materials which are required to change wiring which was not confirmed with the equipment manufacturer's drawings.
- B. Supplier shall provide a skilled programmer/instrumentation engineer or technician who shall complete troubleshooting and start-up to place the entire system into satisfactory operation. The engineer or technician shall make the necessary inspection of the completed installation, make the necessary final field adjustments, and make program revisions are required for start-up.

3.04 ACCEPTANCE TESTING

- A. After the installation is complete, and proper operation has been demonstrated, a 60-day acceptance test shall begin. The entire system shall be required to operate for 60 days with no malfunctions, field repairable malfunctions excepted. Any malfunction during the 60-day test which cannot be corrected within 24 hours by the supplier shall be considered a non-field repairable malfunction and after repairs are complete, the test shall be repeated.
- B. The acceptance test shall apply to all equipment furnished under this Section.

END OF SECTION

This Page Left Blank Intentionally

SECTION 43 22 52

MAGNETIC FLOWMETERS

PART 1 GENERAL

1.01 SUMMARY

- A. This section describes the requirements for electro-magnetic averaging flowmeters and associated transmitters.
- B. Related Sections:
 - 1. Section 40 90 00 – Control System Functional Descriptions

1.02 PERFORMANCE REQUIREMENTS

- A. Provide instruments capable of meeting the following performance requirements when installed in accordance with the manufacturer's recommendations:
 - 1. Measured accuracy within plus or minus 0.5% of rate (see schedule).
 - 2. Measured repeatability within plus or minus 0.1 percent of stated accuracy.
 - 3. Response time, to reach 90 percent of measurement value, adjustable from 1 to 100 seconds.
 - 4. Warm up time not to exceed 10 minutes.
 - 5. Velocity rangeability, 50:1, 0.66 to 33 feet/second. Normal operating velocities 1 to 10 feet/second.
 - 6. Electronics ambient temperature 15 to 131 degrees F.

PART 2 PRODUCTS

2.01 PRIMARY ELEMENT

- A. Meet the following requirements unless noted otherwise on the instrument schedule.
 - 1. Flowmeter body and flanges: Carbon steel
 - 2. Epoxy polyester paint
 - 3. Silicone rubber housing sealant
 - 4. Electrodes: 316 SS for general purpose, Hasteloy C for corrosive and abrasive applications; protruding bullet-nose shape.
 - 5. Liner: Polyurethane or Ebonite meeting NSF requirements.
 - a. Manufacturer to review process diagram and confirm that liner is compatible with exposure to process chemicals.
 - 6. Process connection: flanges, rated 150 psig.
 - 7. Maximum fluid pressure 150 psig.
 - 8. Flow tube shall be submergence rated 3 feet for 30 minutes.
 - 9. Suitable for liquids with conductivity greater than 10 micro-siemens/cm.
 - 10. Maximum fluid temperature with integral electronics, 140 degrees F.
 - 11. Support minimum separation of 30 ft from primary element to transmitter where separate electronics are indicated.
 - 12. Stainless steel grounding rings shall be furnished for all flow meters.
- B. Nominal size shall be as identified in the meter schedule in Part 3 of this Section.

2.02 AMPLIFIER/TRANSMITTER

- A. Meet the following requirements unless noted otherwise on the instrument schedule.
 - 1. Design: Microprocessor based technology electronics
 - a. Pulsed D.C. system powers flow tube coils.
 - b. Self-diagnostics aids to maintenance and service.
 - c. Modular construction with plug-in circuit cards and options.
 - d. Continuous automatic re-zeroing calibration
 - e. Variable damping capability with an adjustable range of 0.5 to 30 seconds
 - f. Adjustable low flow cutoff circuitry locks output signal at 4ma and provides contact signal output for alarm
 - 2. The amplifier/transmitter shall be remotely mounted from the primary element.
 - 3. The amplifier/transmitter shall be capable of automatic dual range switching and bi-directional flow indication.
 - 4. Display:
 - a. Provide simultaneous digital indication of flow rate in percent of span or engineering units and totalization in engineering units.
 - b. Totalizers shall be provided for forward, reverse and differential flow.
 - c. Characters 6mm or larger.
 - 5. Outputs:
 - a. Isolated 4-20ma for use by the supervisory control system.
 - b. Open collector scaleable pulse output rated 30VDC for each direction.
 - 6. Alarms: High and low; adjustable set-points; isolated output SPDT contacts, 2amp 120vac.
 - 7. Enclosure: NEMA 4 rated enclosure.
 - 8. Incoming Power: 120Vac 60Hz, 50 watts, or less
 - 9. Signal: Manufacturer's sensor cable connection direct from sensor to instrument housing via flexible weather-proof conduit.
 - 10. Provide separate conduits for signal and power wiring to the meter and between the transmitter and control panel. Meter shall be grounded in accordance with manufacturer's instructions.

2.03 MANUFACTURERS

- A. Accepted manufacturers:
 - 1. Emerson Rosemount Model 8750 with Smart Meter Verification Technology.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Verify exact mounting location and orientation with factory trained field representative.
- B. Never install a meter where gas can collect or a line can self-drain when flow stops.
- C. Install meters where the pipe remains full at all times.
- D. Install meters in vertical pipes where flow is upward.
- E. Install separate conduits for signal and power wiring to the meter and between the transmitter and control panel.
- F. Install the transmitter remotely from the primary element.
- G. Ground the meter in accordance with manufacturer's instructions.

3.02 MAGNETIC FLOW METER CALIBRATION

- A. Factory Calibration: Flow calibration of the magnetic flow meter shall be performed in the Factory and the calibration report submitted as part of the Shop Drawing.

3.03 FLOW METER SCHEDULES

Tag	Location	Size (inches)	Process Stream	Setting
FE/FIT-00	Filter 1 Room	12	Filter 1 Effluent	Standard
BW-FE/FIT-1	Filter 2 Room	12	Filter 2 Effluent	Standard

END OF SECTION

This Page Left Blank Intentionally

GAS CHLORINE FEED EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Modify existing chlorination system to include new automatic chlorinator. New chlorinator to connect existing vacuum regulators and automatic switchover system to existing remote flowmeter and ejector.
 - 2. New equipment in the chlorine system shall include chlorinators, ball valves, and all other related accessories.
 - 3. Supply all additional piping and miscellaneous items necessary to operate equipment.
 - 4. Materials or features not specified herein shall be manufacturer's standard for equipment and shall be included to comprise a complete and reliable system suitable for specified operating conditions.
 - 5. All piping and chemical feed equipment shall be suitable for use and immune from attack by chlorine gas.
- B. Related Sections
 - 1. Section 40 23 10 - Process Water and Waste Piping
 - 2. Section 40 23 40 - Process Piping Hangers and Supports

1.02 SYSTEM DESCRIPTION

- A. Provide a chlorination system.
 - 1. Chlorination: a solenoid valve shall open to provide water at distribution system pressure when the filters are producing water. The chlorination system shall become operational and feed chlorine when the Well 8 and/or 9 pump(s) are running. The SCADA system shall provide a signal to start and stop the chlorinator output, and an existing rotameter shall control the chlorine feed rate.

1.03 SUBMITTALS

- A. Submit Shop Drawings and product data in accordance with Section 01 33 00 and include the following:
 - 1. Shop drawings indicating system schematics, equipment locations, details, and control schematics.
 - 2. Product data indicating chemical treatment methods, chemicals, and equipment.
 - 3. Manufacturer's installation instructions.
- B. Submit reports in accordance with Section 01 75 00 and include:
 - 1. Report indicating start-up of treatment system is completed and operating properly.
 - 2. Report indicating analysis of system water after treatment.
 - 3. Report indicating analysis of chlorine residuals measured immediately after the injecting point.
- C. Operation and Maintenance Manuals
 - 1. Prior to start-up, the Contractor shall furnish operation and maintenance manuals in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

- A. Single Source Responsibility: All components to be provided by one (1) supplier.
- B. Qualifications:
 - 1. Manufacturer/supplier shall have minimum five (5) years documented experience in the manufacture and installation of gas chlorination systems.
 - 2. Manufacturer/supplier shall maintain full-time service staff.

- C. All materials and equipment provided in this section and shown on the Drawings shall comply with the recommended practices and standards for The Chlorine Institute, Inc.

PART 2 PRODUCTS

2.01 COMPONENTS

- A. The manufacturer of the gas chlorination system equipment specified here within shall be:
 - 1. Hydro Instruments, Telford, PA.
- B. Remote Gas Feed Panel:
 - 1. A shop-fabricated remote chlorine gas feed panel shall be provided to contain all chlorine gas feed equipment. All components of the remote gas feeder shall be panel-mounted. Maximum panel width is 24 inches. At a minimum, the panel shall contain:
 - a. Sch. 80 PVC chlorine gas header and isolation true union ball valves connecting the Automatic Switchover Module.
 - 2. Capacity:
 - a. 100 ppd.
- C. Automatic Gas Feeder:
 - 1. Provide automatic gas feeder capable of regulating the rate of chlorine gas provided to the system.
 - 2. Include local display of gas feed rate.
 - 3. Flow Pacing capability via 4-20 mA input, and minimum of two (2) 24 VDC contact signals for Step Feed option.
 - 4. 4-20 mA output to PLC for communication of gas feed rate.
 - 5. 110 V power supply
 - 6. Corrosion and erosion resistant for contact with chlorine gas.
 - 7. Construction:
 - a. Valve Body: PVC
 - b. Gaskets: PTFE
 - 8. Automatic gas flow shut-off upon loss of water.
- D. Ball Valves:
 - 1. Provide True Union Sch. 80 PVC ball valves meeting the requirements of Section 40 23 20.
 - 2. Provide ball valves upstream and downstream of the ejectors, diffusers, and solenoid valves. Provide ball valves to isolate pressure gauges and vacuum gauges.
- E. Chemical Solution Tubing and Piping:
 - 1. Chlorination vacuum tubing shall be flexible PTFE 3/8-inch diameter or size recommended by chlorination equipment supplier. Tubing shall be installed in appropriately sized PVC carrier piping from the chlorine vacuum regulator to the gas feeders and ejectors.
 - 2. Pipe for the chlorination system shall be in 3/8-inch, Schedule 80 PVC pipe.
 - 3. Provide transition couplings and fittings necessary for connection to solution diffuser.
- F. Accessories
 - 1. All pipe supports shall be FRP Unistrut per Section 40 23 40.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install equipment at the locations shown on the Drawings.
- B. Install equipment and accessories in accordance with the manufacturer's instructions.

- C. Chlorine feed system shall include all necessary equipment and accessories for a completely functioning chlorine feed system including but not limited to an ejector, diffuser, valves, connectors, chlorine tubing and conduit, plant water piping, and fittings.
- D. Chlorine vacuum tubing shall be installed in Schedule 40 PVC carrier pipe without elbows or bends to provide a rigid and neat installation.
- E. Provide vent lines from the regulators to the building exterior. The vent line shall extend out from the exterior building finish as to prevent damage to the finish material. The vent line shall not be directly attached to the building exterior.
- F. Provide an insect screen on the exterior end of the vent line.

3.02 INSPECTION, START-UP & ADJUSTMENT

- A. Manufacturers Field Services:
 - 1. Inspect and approve final system installation prior to start-up.
 - 2. Provide minimum one (1) 8-hour day on site for supervision of installation and start-up.
 - 3. Provide one (1) hour/month for further instruction on maintenance and system operation for the first year of operation via teleconferencing or phone.

3.03 OPERATOR TRAINING

- A. Provide a minimum of 4 hours of operator training at the Owner's convenience after equipment is operational. See Section 46 00 00.
- B. Training shall take place during a separate trip to the site from start-up.
- C. The plant's personnel shall be sufficiently trained and thoroughly acquainted with the operations and maintenance materials to operate all components of the system.

END OF SECTION

This Page Left Blank Intentionally

This Page Left Blank Intentionally



Building a Better World
for All of Us®

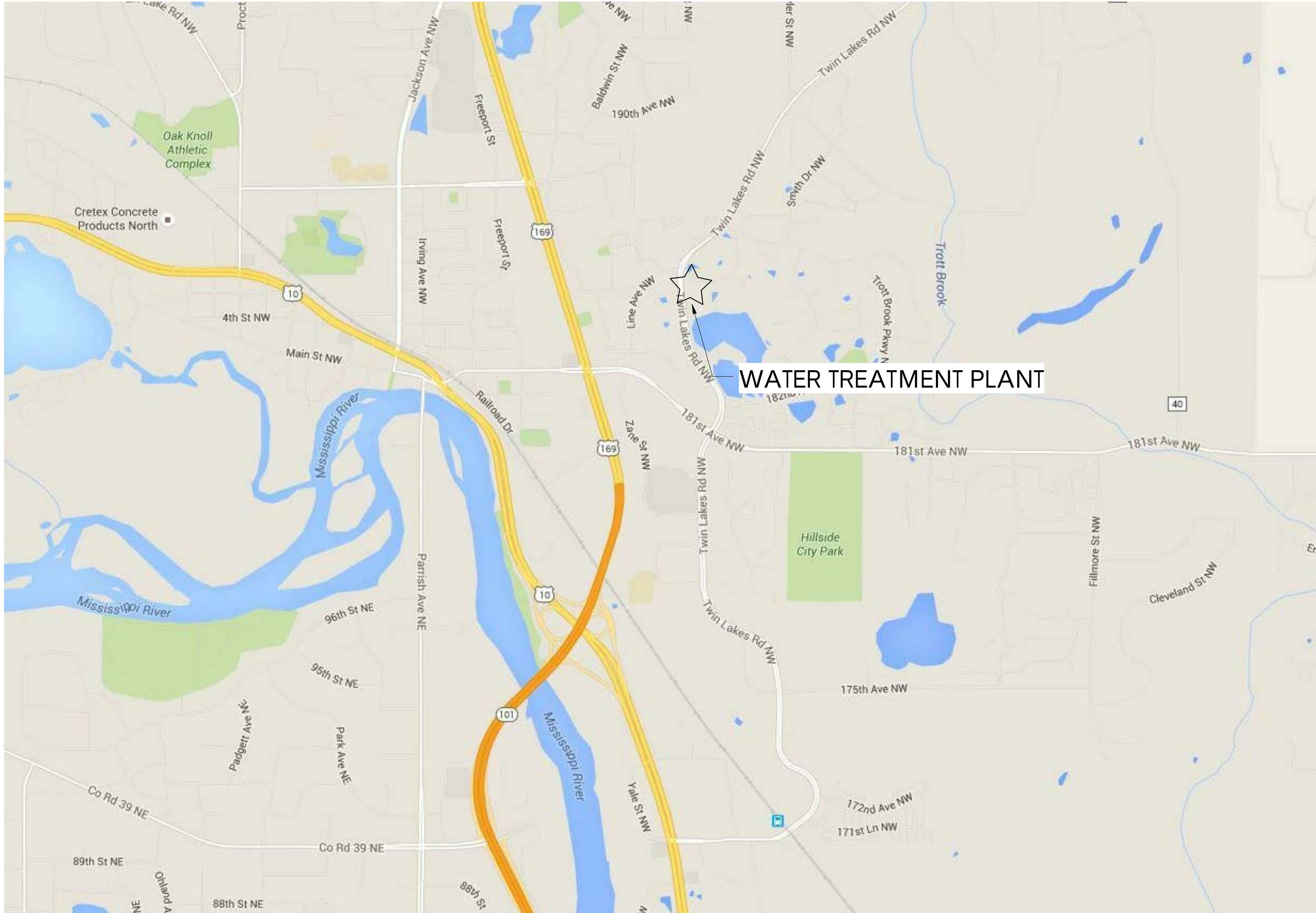
Engineers | Architects | Planners | Scientists

CONSTRUCTION DRAWINGS FOR

WELL 7/9 WATER TREATMENT PLANT

IMPROVEMENTS FOR WELL 8

ELK RIVER MUNICIPAL UTILITIES



LOCATION MAP

3535 VADNAS CENTER DR
ST PAUL, MN 55110
TEL: 651.480.2160
FAX: 651.480.2160
WATTS: 900.325.2055
www.sehinc.com

WELL 7/9 WATER TREATMENT
PLANT IMPROVEMENTS FOR WELL 8

ELK RIVER MUNICIPAL UTILITIES

ELK RIVER, MN

MARK	DATE	DESCRIPTION
		REVISIONS

FILE NO. ELKMU 192017

CITY PROJECT NO.

ISSUE DATE 08/05/2026

DESIGNED BY BJW

DRAWN BY AWK

Small Elliott-Hendrickson, Inc. © (SEH)

SHEET TITLE

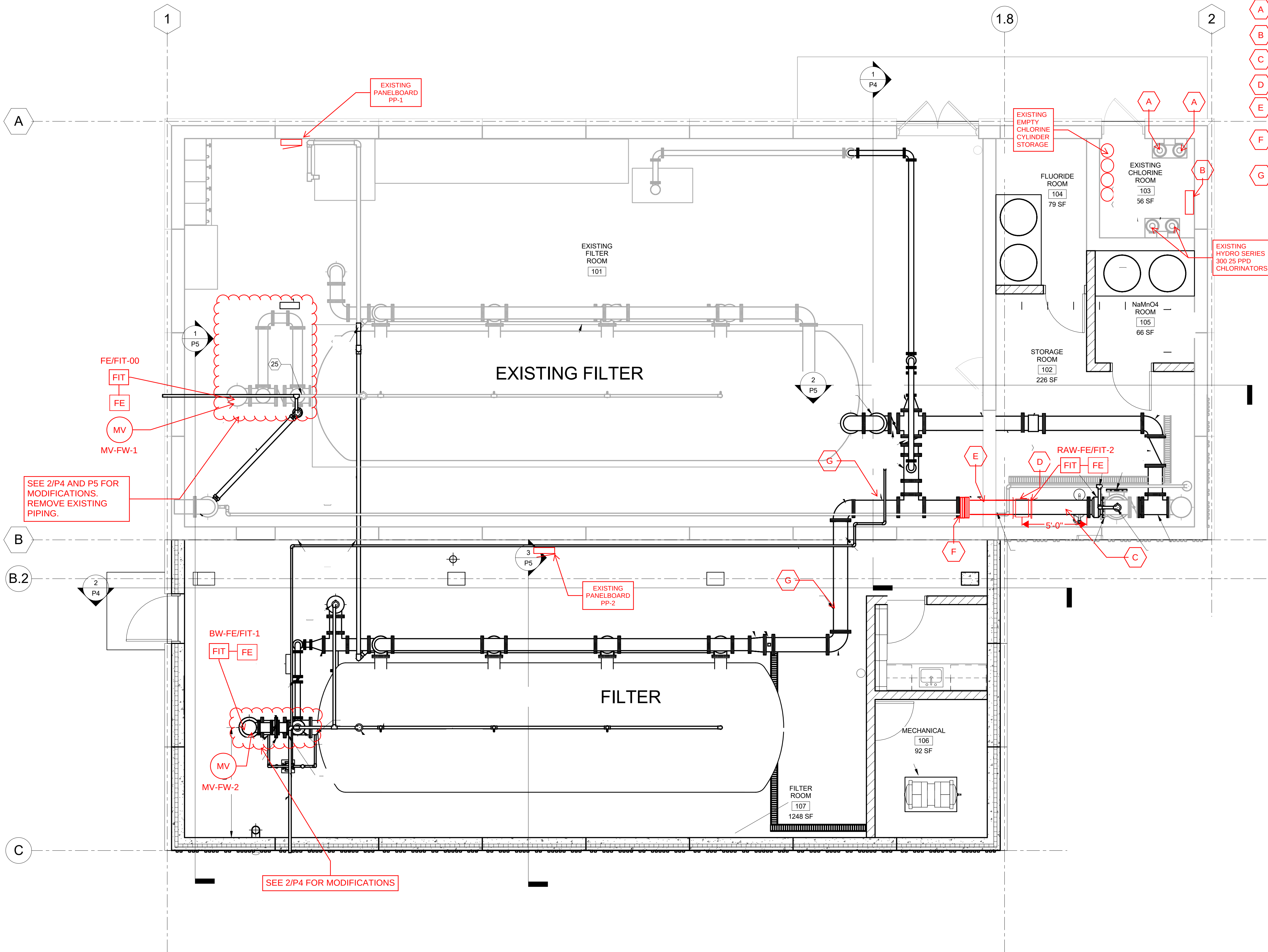
GENERAL

TITLE SHEET

SHEET

G1

- PROCESS/ELECTRICAL PLAN KEYNOTES
- A REPLACE EXISTING HYDRO SERIES 300 50 PPD CHLORINATORS WITH 100 PPD CHLORINATORS
 - B NEW 100 PPD AUTOMATIC CHLORINATOR. SEE SCHEMATIC E/PPD1
 - C MODIFY 12" PIPE SPOOL TO ACCOMMODATE NEW FLOWMETER LOCATION
 - D RELOCATE EXISTING 12" FLOWMETER RAW-FE/FIT-2
 - E NEW 12" PIPE SPOOL. USE EXISTING WALL PENETRATION
 - F NEW WAFER-STYLE STATIC MIXER WITH CHEMICAL FEED CONNECTIONS. CONNECT RELOCATED CHLORINE AND PERMANGANATE FEED LINES
 - G RELOCATE EXISTING 12" CHEMICAL FEED POINT



1 PROCESS PLAN VIEW
P3 0 2' 4' 8'

3535 VADNAS CENTER DR
ST PAUL, MN 55110
TEL: 651.480.2160
FAX: 651.480.2160
WATTS: 600.325.2055
www.sehinc.com

SEH

WELL 719 WATER TREATMENT
PLANT IMPROVEMENTS FOR WELL 8
ELK RIVER MUNICIPAL UTILITIES
ELK RIVER, MN

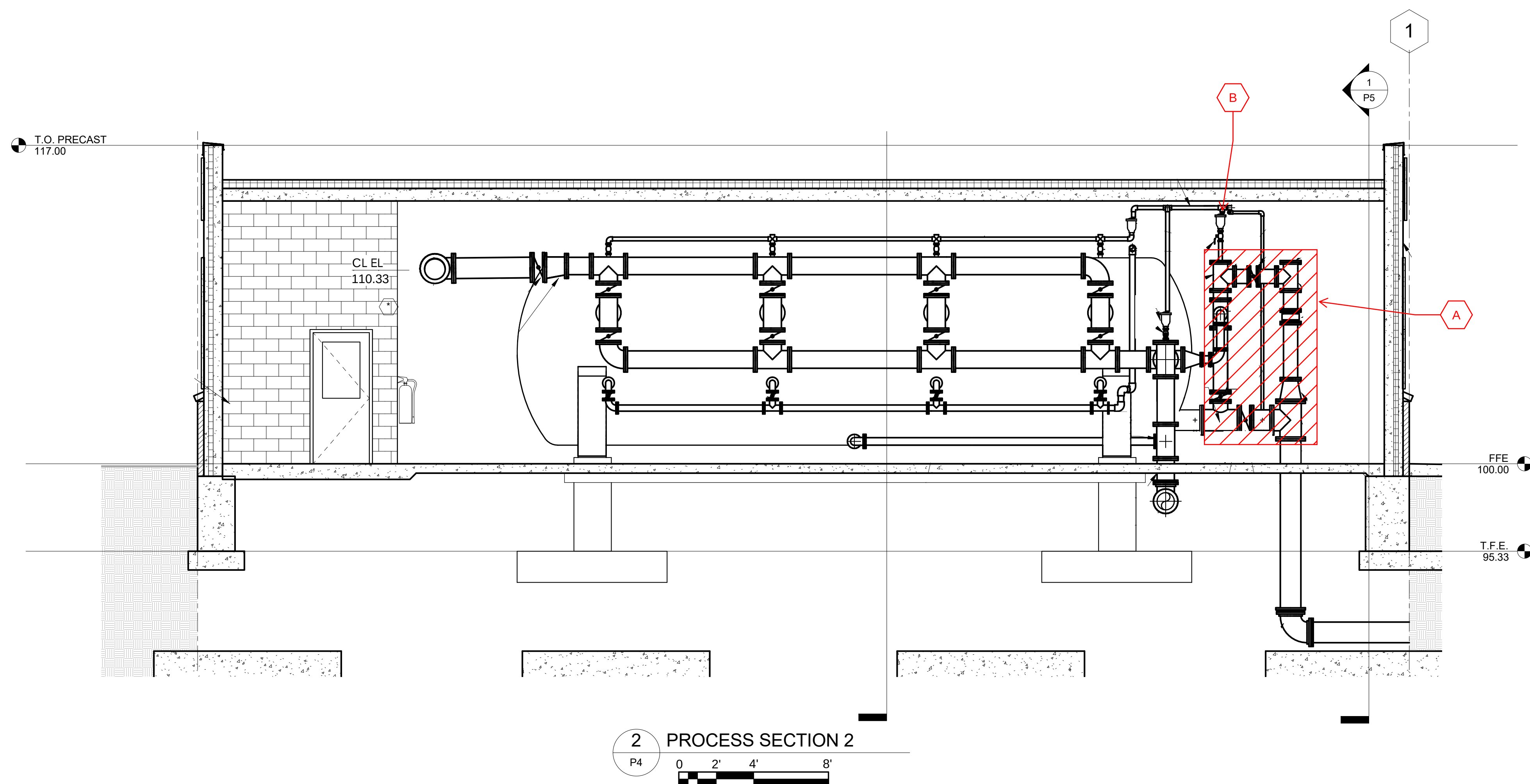
MARK	DATE	DESCRIPTION

FILE NO. ELKMU 192017
CITY PROJECT NO. 08/04/2026
ISSUE DATE B3W
DESIGNED BY AWK
DRAWN BY

Short Elliott Hendrickson, Inc. © (SEH)

SHEET TITLE
PROCESS FLOOR PLAN

SHEET
P3



PROCESS PLAN KEYNOTES:

- A REMOVE FILTER EFFLUENT PIPING. REINSTALL 4" PIPING. SEE P4 - PROCESS PIPING.
- B REMOVE AND SALVAGE AIR RELEASE VALVE AND ISOLATION VALVE FOR REINSTALLATION

GENERAL DEMO NOTES:

- 1. CONTRACTOR SHAL SALVAGE ALL PIPE, FITTINGS, AND VLVES FOR REUSE AS INDICATED. REMAINING PIPE FITTINGS AND VALVE SHALL BE TURNED OVER TO OWNER.

3535 VADNAS CENTER DR
ST PAUL, MN 55110
TEL: 651.480.2160
FAX: 651.480.2160
WWW.SEHINC.COM

WELL 719 WATER TREATMENT
PLANT IMPROVEMENTS FOR WELL 8
ELK RIVER MUNICIPAL UTILITIES
ELK RIVER, MN

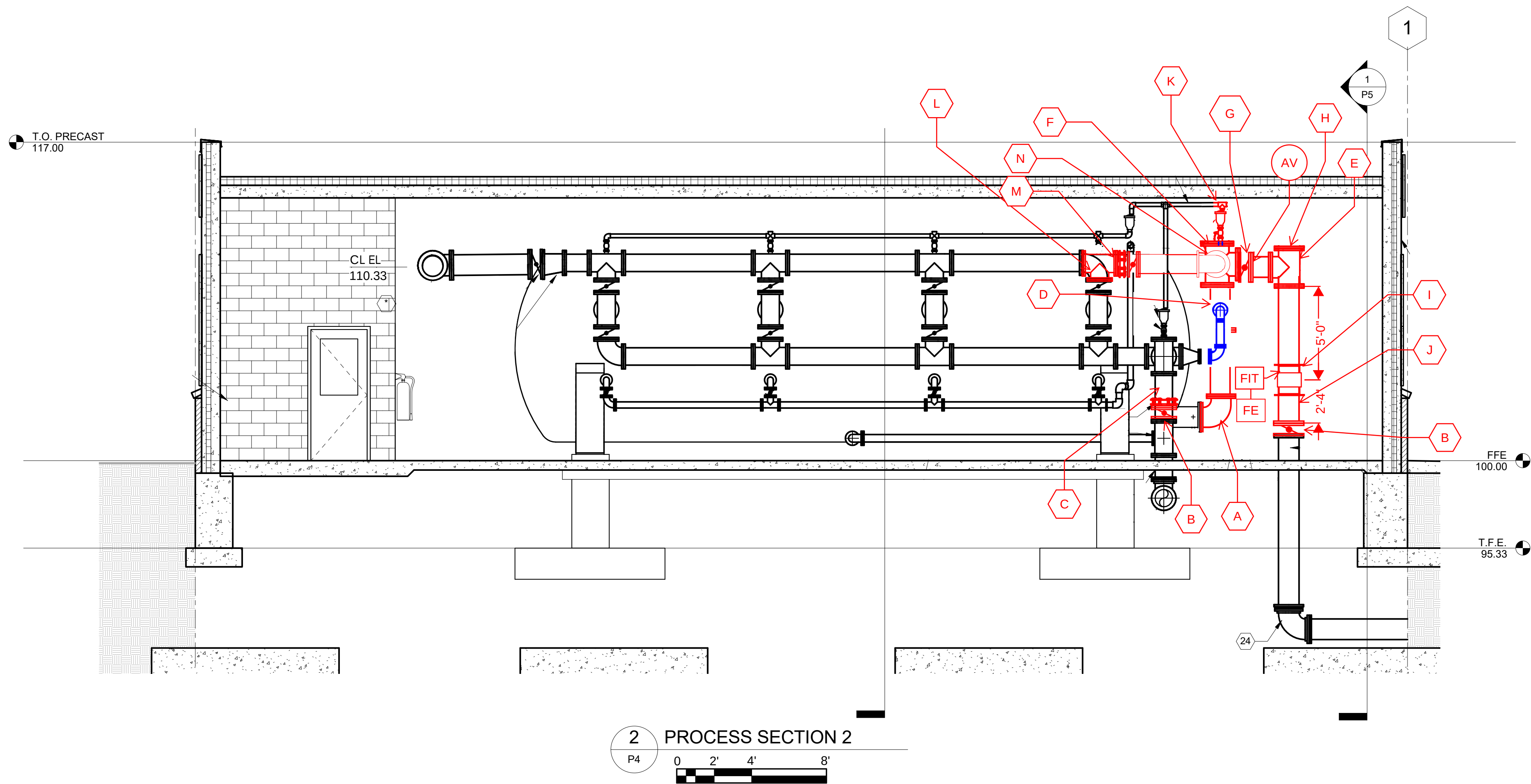
MARK	DATE	DESCRIPTION
REVISIONS		

FILE NO.	ELKMU 192017
CITY PROJECT NO.	08/04/2026
ISSUE DATE	RJW
DESIGNED BY	AWK
DRAWN BY	

Shon Elliott Herndrickson, Inc. © (SEH)

PROCESS DEMOLITION
PLANS

P4



PROCESS PLAN KEYNOTES:

- A 12" 90. TAP SIDE OF 90 AND REINSTALL SAMPLE LINE
- B 12" BUTTERFLY VALVE WITH HANDWHEEL
- C ADD SAMPLE TAP. SEE C/PD2
- D 12"X4" TEE. RECONNECT EXISTING 4" PIPING (SHOWN IN BLUE)
- E 12" TEE
- F 12" BLIND FLANGE WITH TAP. REINSTALL EXISTING AIR RELEASE VALVE
- G 12" ELECTRICALLY ACTUATED BUTTERFLY VALVE
- H 12" BLIND FLANGE WITH TAP. RECONNECT EXISTING WATER SUPPLY PIPING.
- I 12" FLOWMETER
- J TAP SPOOL PIECE FOR CHLORINE AND FLUORIDE FEED. SEE B/PD1 AND D/PD1.
- K REINSTALL EX. ARV
- L REMOVE 12" 90 AND REPLACE WITH 12" TEE
- M 12" BUTTERFLY VALVE WITH CHAINWHEEL
- N 12" FOUR WAY SIDE OUTLET TEE

GENERAL DEMO NOTES:

- 1. CONTRACTOR SHAL SALVAGE ALL PIPE, FITTINGS, AND VLVES FOR REUSE AS INDICATED. REMAINING PIPE FITTINGS AND VALVE SHALL BE TURNED OVER TO OWNER.

3535 VADNAS CENTER DR
ST PAUL, MN 55110
TEL: 651.480.2160
FAX: 651.480.2160
WATTS: 900.325.2055
www.sehinc.com

WELL 7/9 WATER TREATMENT
PLANT IMPROVEMENTS FOR WELL 8
ELK RIVER MUNICIPAL UTILITIES
ELK RIVER, MN

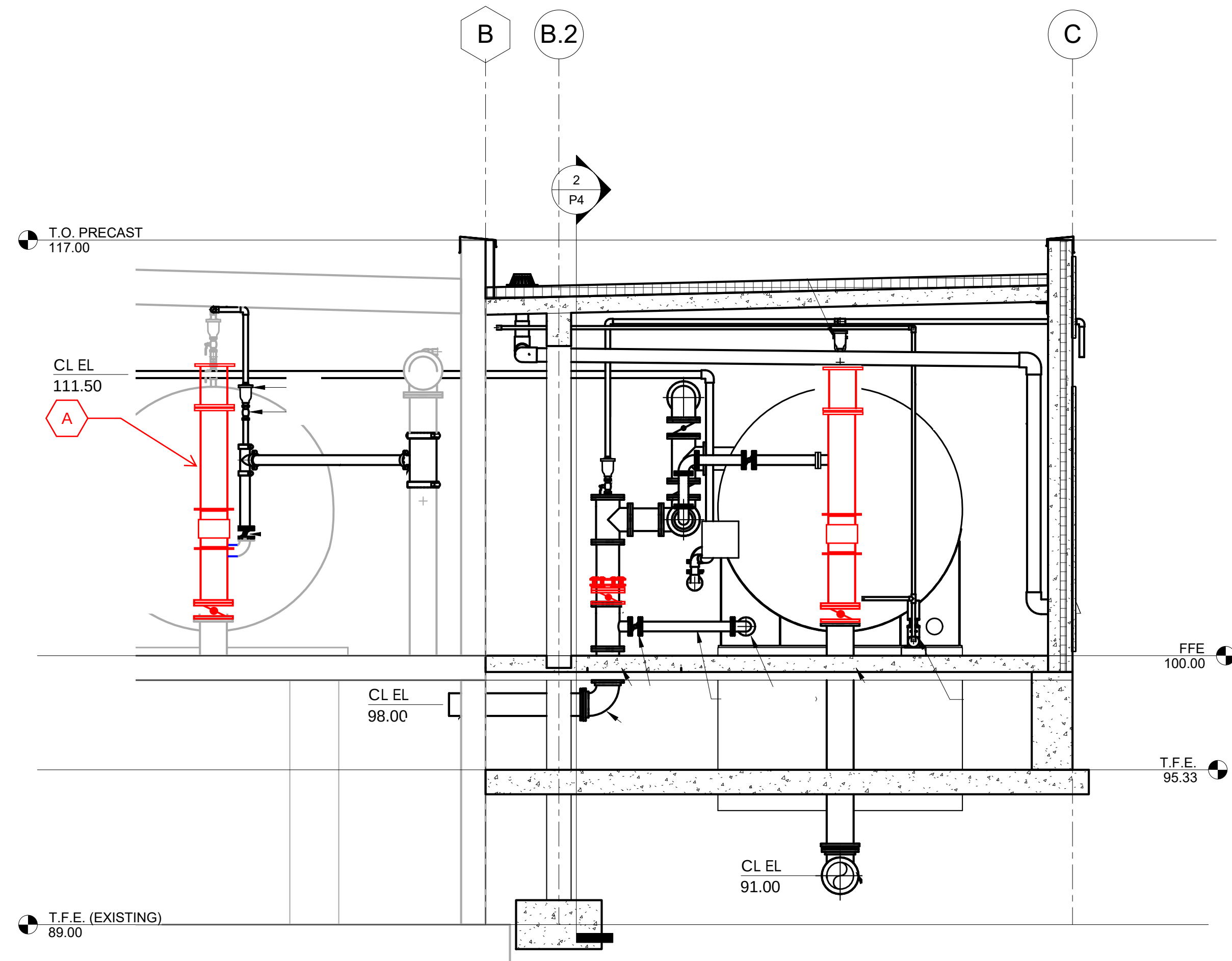
MARK	DATE	DESCRIPTION
		REVISIONS

FILE NO. ELKMU 192017
CITY PROJECT NO. 08/04/2026
ISSUE DATE 03/04/2026
DESIGNED BY BJW
DRAWN BY AWK

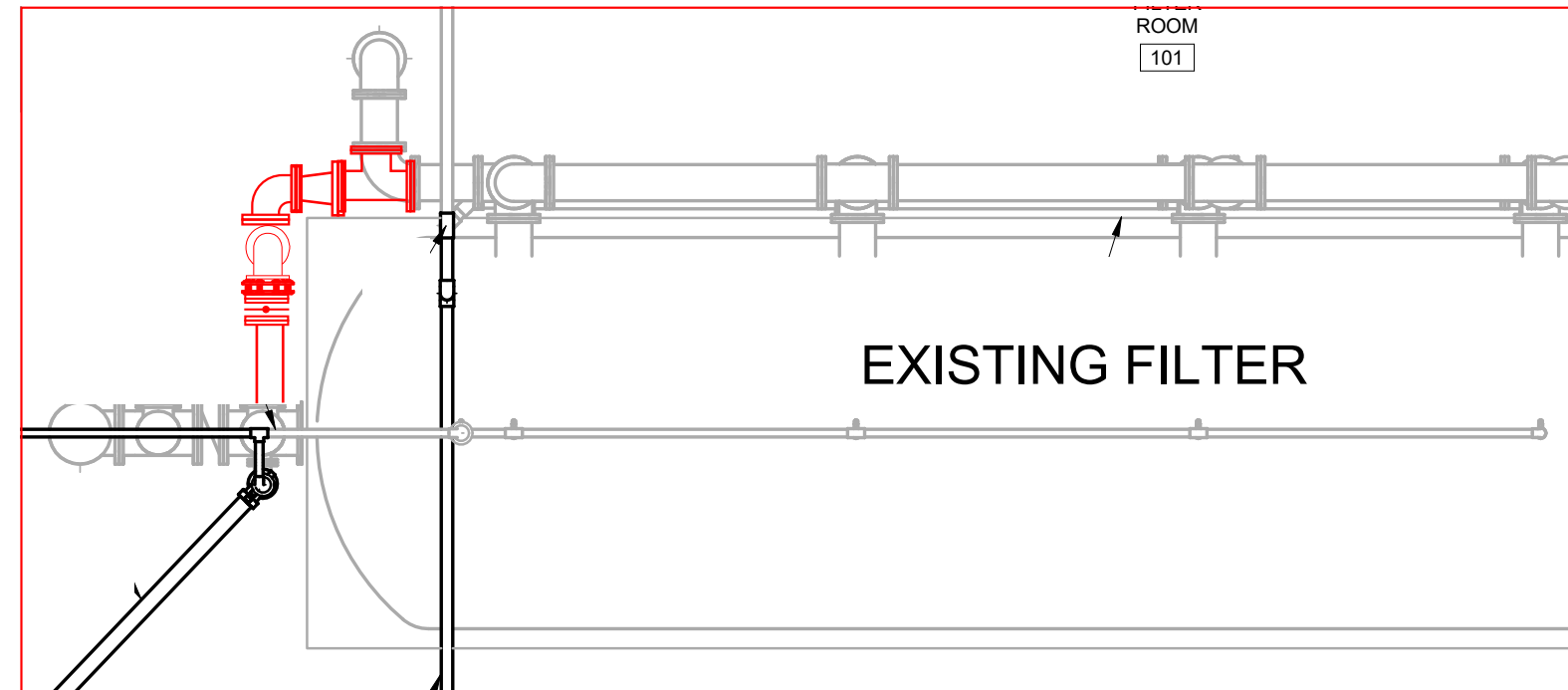
Short Elliott Hendrickson, Inc. © (SEH)

SHEET TITLE
PROCESS
PROCESS SECTIONS

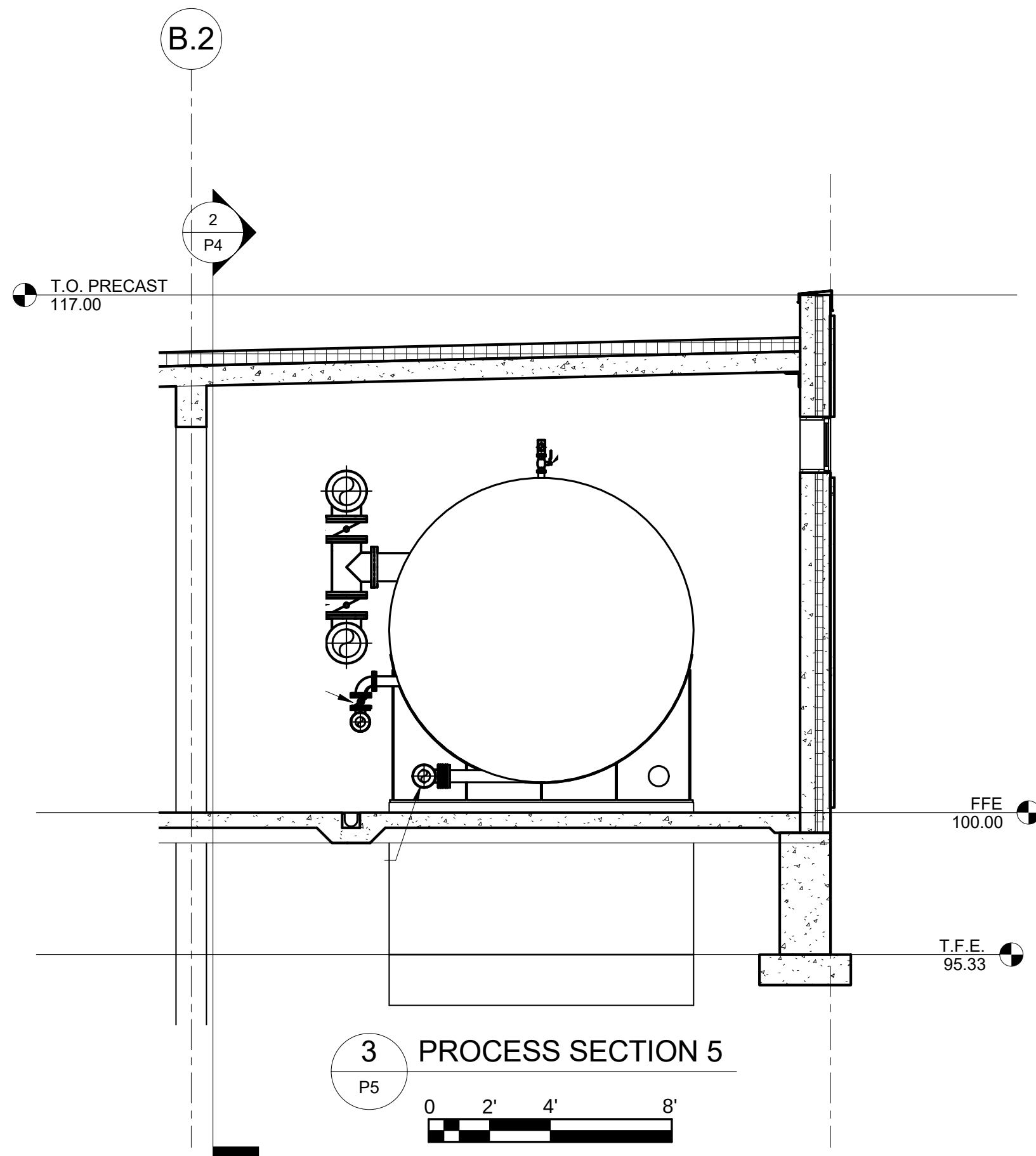
SHEET
P4



1
P5
PROCESS SECTION 3
0 2' 4' 8'



4/P5 PROCESS SECTION 6



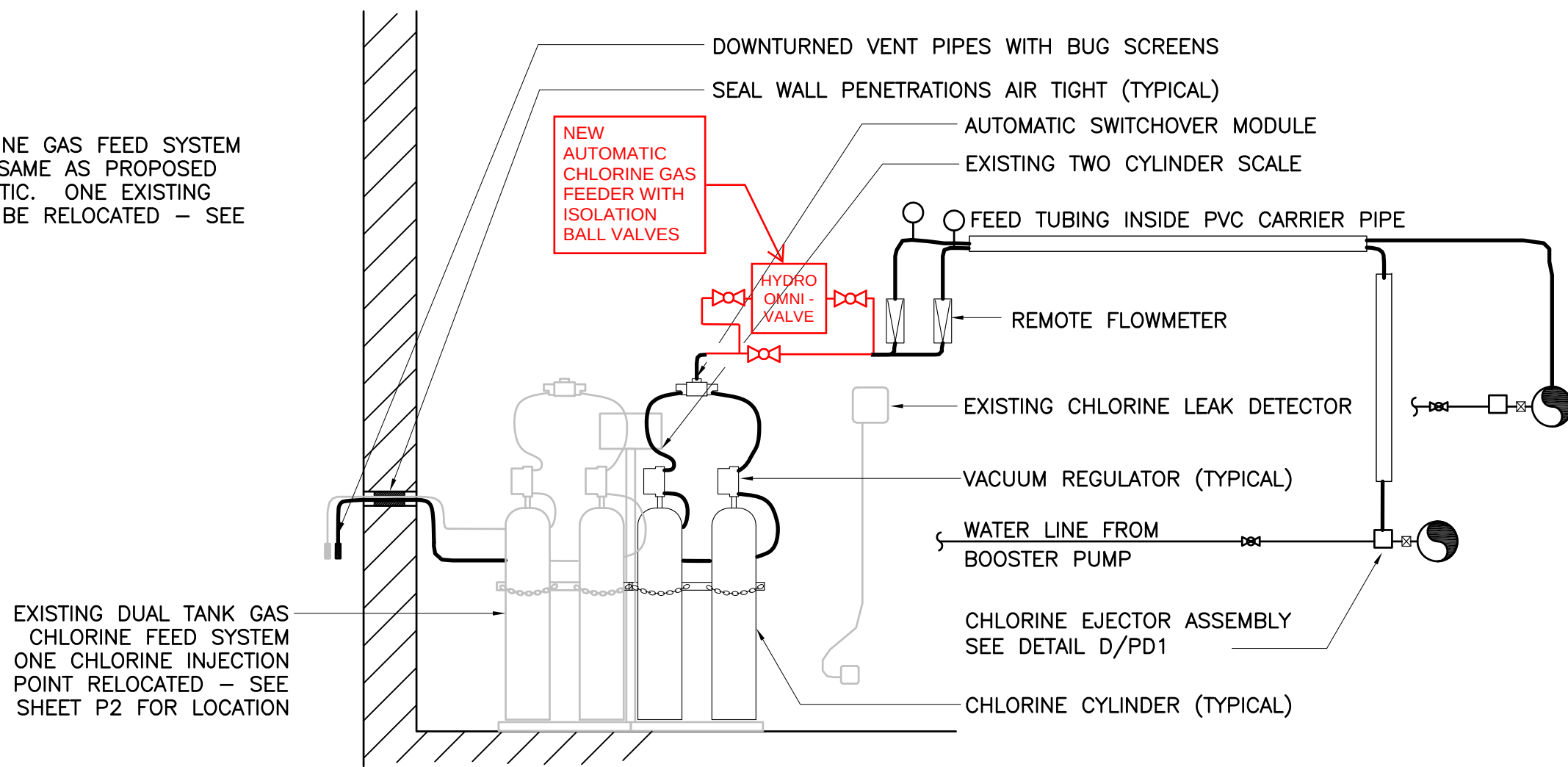
3
P5
PROCESS SECTION 5
0 2' 4' 8'

PROCESS PLAN KEYNOTES:

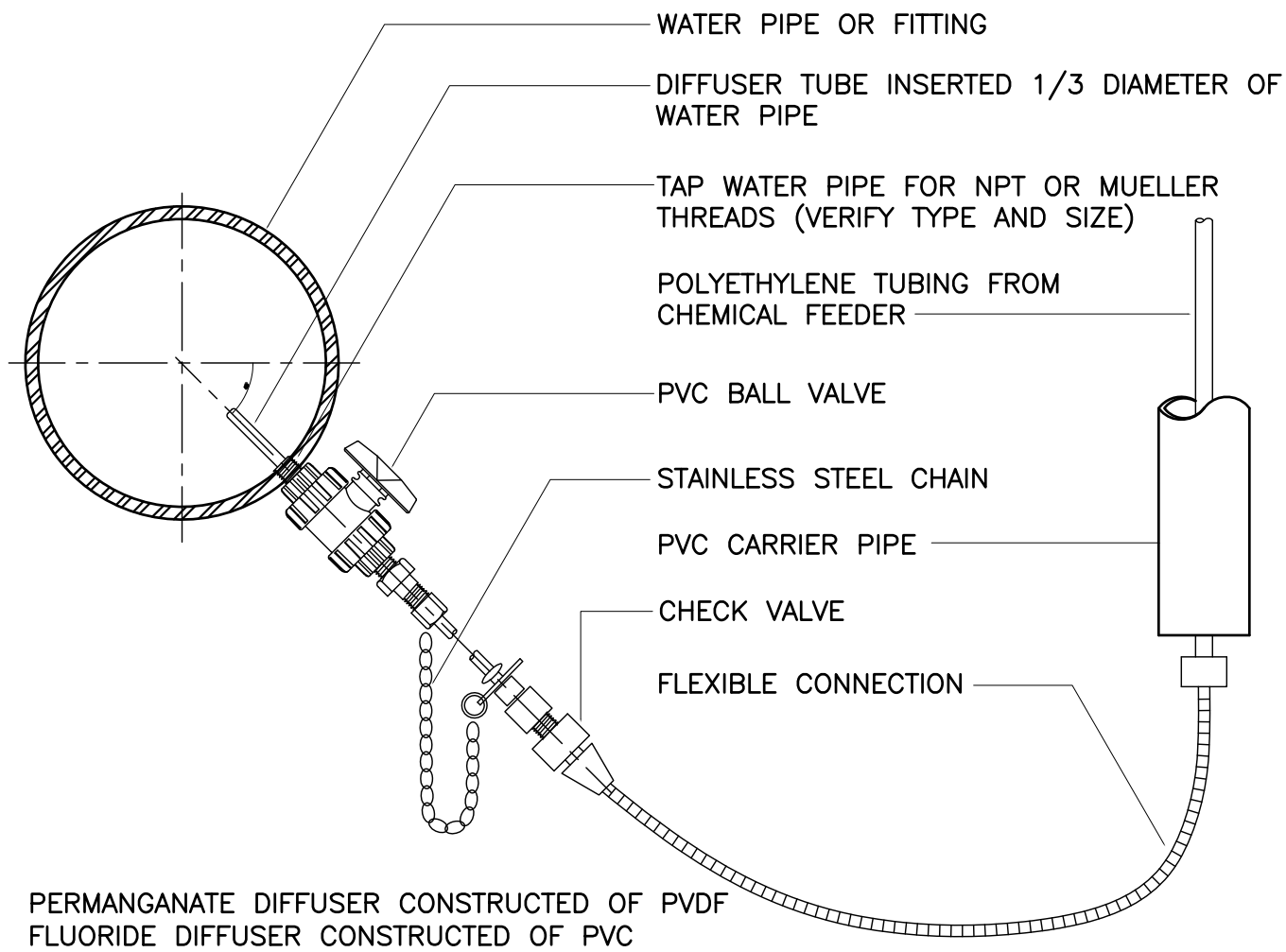
MODIFY PIPING TO BE EQUIVALENT TO UPDATED 2/P4. REPLACE ALL 8" PIPING WITH 12" PIPING. SALVAGE AND REINSTALL GAUGES, SAMPLE PORTS, AND AIR RELEASE VALVE.

NOTES:

1. EXISTING CHLORINE GAS FEED SYSTEM NOT SHOWN – SAME AS PROPOSED SYSTEM SCHEMATIC. ONE EXISTING FEED POINT TO BE RELOCATED – SEE SHEET P2



CHLORINE GAS FEED SYSTEM DETAIL



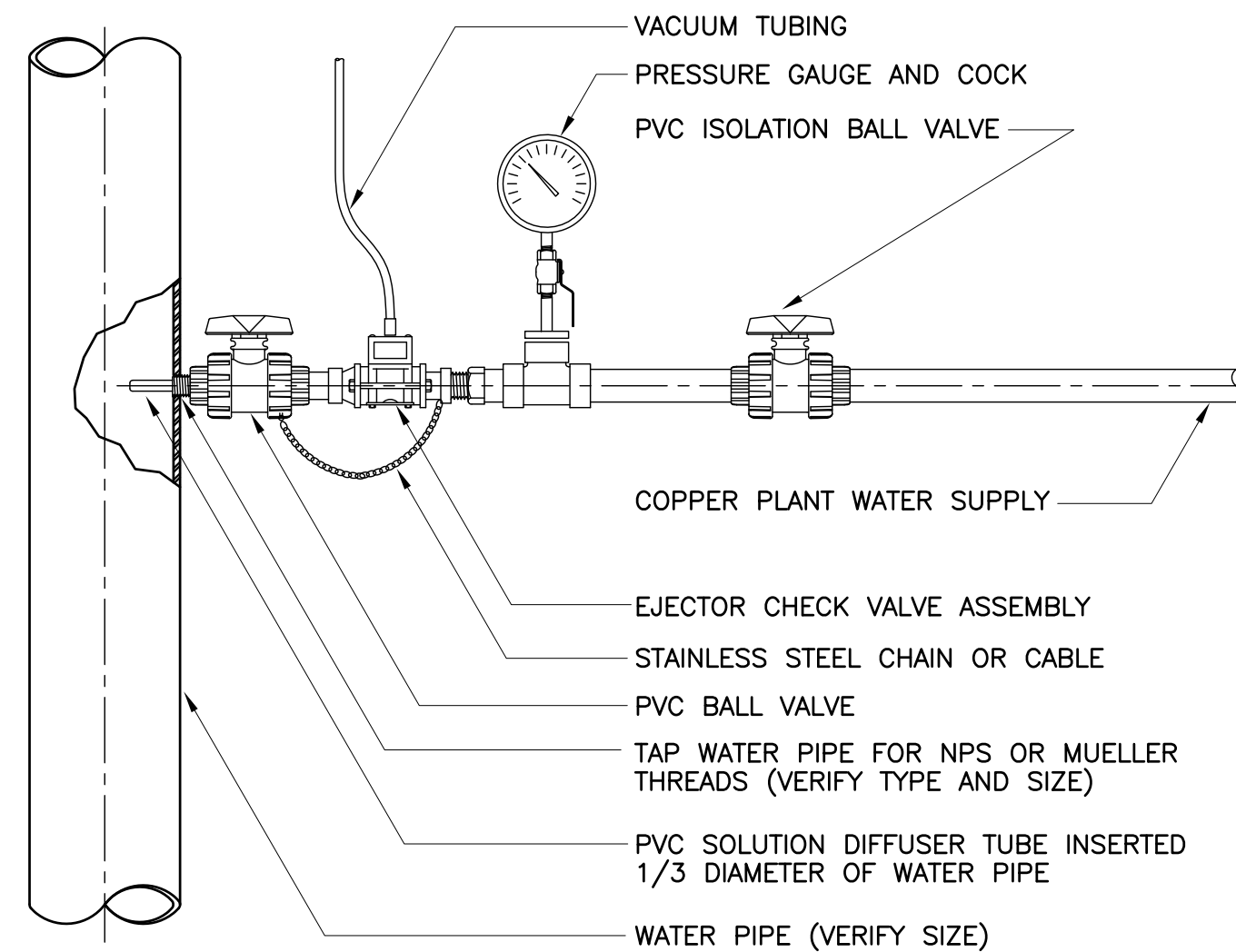
PERMANGANATE DIFFUSER CONSTRUCTED OF PVDF
FLUORIDE DIFFUSER CONSTRUCTED OF PVC

CHEMICAL DIFFUSER DETAIL

B
PD1

SCALE: NONE

PCHEM002

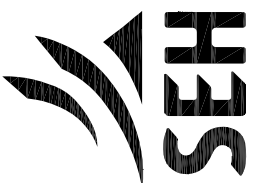


D
PD1

SCALE: NONE

PCHEM001

3535 VADNAN CENTER DR
ST. PAUL, MN 55110
TEL: 651.480.2150
FAX: 651.480.2150
WWW.SEHINC.COM



WELL 719 WATER TREATMENT
PLANT IMPROVEMENTS FOR WELL 8
ELK RIVER MUNICIPAL UTILITIES
ELK RIVER, MINNESOTA

MARK DATE DESCRIPTION REVISIONS

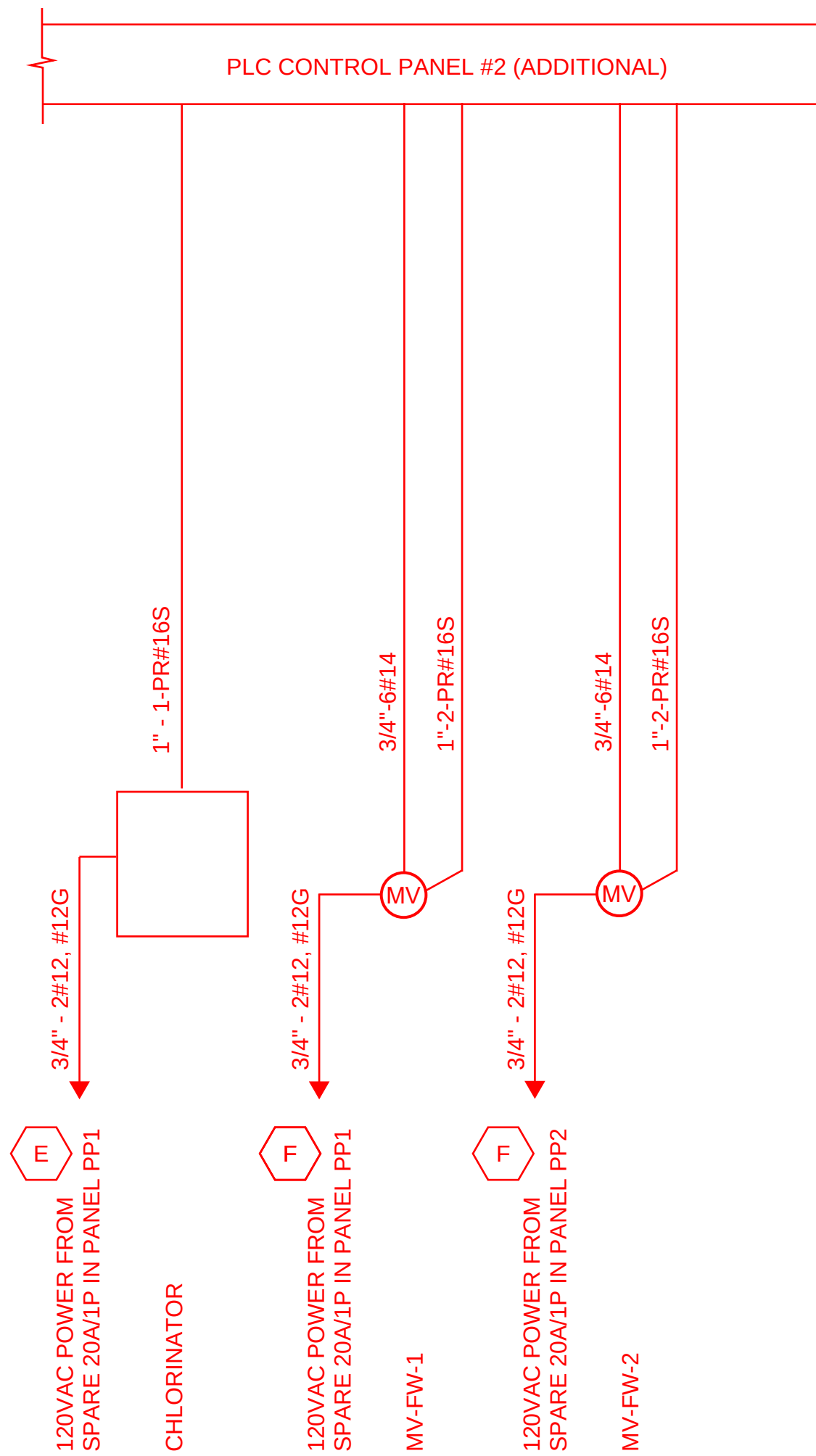
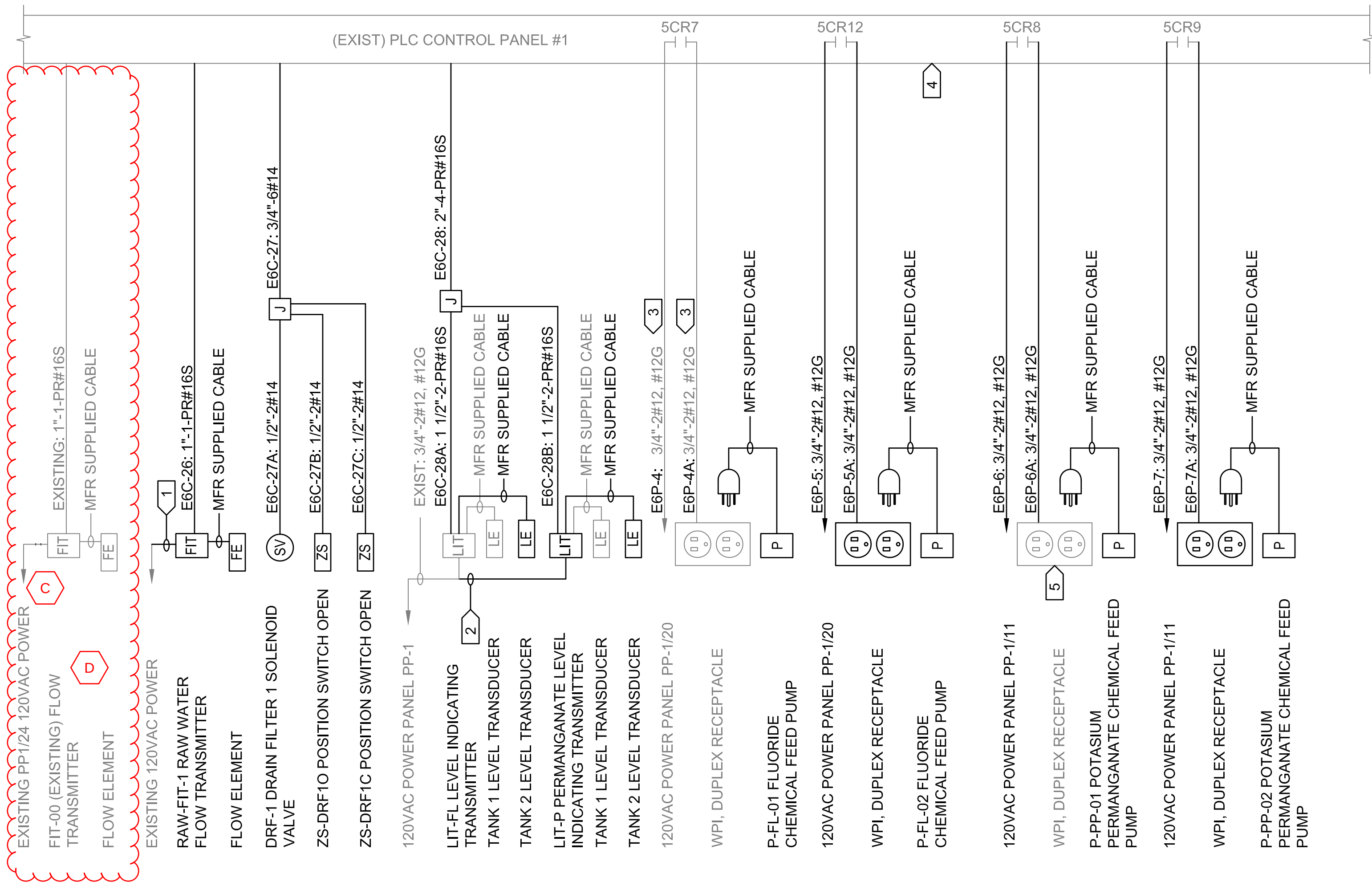
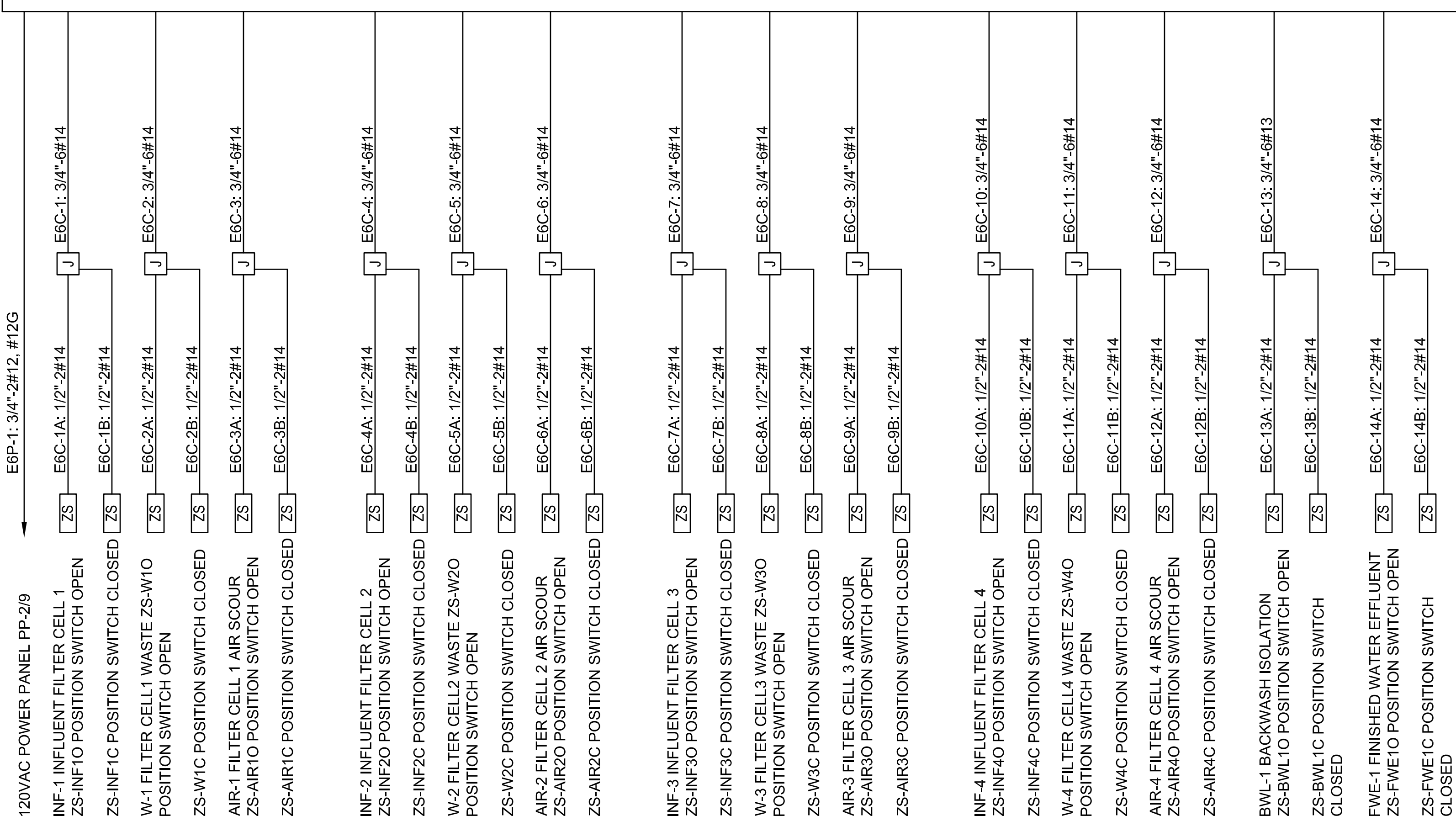
SEH FILE NO. ELKMU 192017
PROJECT NO. 08/04/2026
ISSUE DATE BJJ
DESIGNED BY
DRAWN BY
Short Elliott Henderson, Inc. © (SEH)

SHEET TITLE
PROCESS DETAILS

SHEET

PD1

PLC CONTROL PANEL #2



GENERAL NOTES:

- AREA TYPE 1A WIRING DEVICES SHALL BE CORROSION REISTANT.
- ONLY ITEMS IN RED OR MARKED OUT IN RED ARE IN THE SCOPE.
- REFER TO PROCESS DRAWINGS FOR IDENTIFICATION OF DEVICES AND EQUIPMENT LOCATION.

KEYNOTES:

- DISCONNECT AND REMOVE BACK ALL POWER AND CONTROL WIRING FOR EXISTING RAW WATER FLOW METER BACK TO SOURCE. ONLY REMOVE CONDUIT BACK TO NEAREST FITTING OUTSIDE OF WORKSPACE. RAW WATER FLOW METER TO BE SALVAGED. DISCONNECT AND SALVAGE WIRING BETWEEN TRANSMITTER AND ELEMENT. FOLLOWING COMPLETION OF SALVAGED FLOW METERS INSTALLATION, RUN NEW WIRING FROM EXISTING PLC CONTROL PANEL #2, MATCHING WITH REMOVED WIRING, TO FLOW TRANSMITTER, MATCHING WITH EXISTING CONDUIT. REROUTE CABLE BETWEEN TRANSMITTER AND ELEMENT USING SALVAGED CABLE.
- DISCONNECT AND REMOVE ALL POWER AND CONTROL WIRING FOR EXISTING BACKWASH FLOW METER BACK TO SOURCE. ONLY REMOVE CONDUIT BACK TO NEAREST FITTING OUTSIDE WORKSPACE. EXISTING BACKWASH FLOW METER TO BE REMOVED. FOLLOWING COMPLETION OF NEW FLOW METER INSTALLATION, RUN NEW WIRINGS FROM EXISTING PLC CONTROL PANEL #2, MATCHING WITH REMOVED WIRING, TO FLOW TRANSMITTER AND ALSO EXTEND CONDUIT TO NEW FLOW TRANSMITTER, MATCHING WITH EXISTING CONDUIT. FURNISHED CABLES BETWEEN NEW FIT AND FE TO BE INSTALLED BY ELECTRICAL CONTRACTOR.
- REFEED FLOW METERS FROM SAME PANEL AND CIRCUIT.
- DISCONNECT AND REMOVE ALL POWER AND CONTROL WIRING FOR FLOW METER FIT-00 BACK TO SOURCE. ONLY REMOVE CONDUIT BACK TO NEAREST FITTING OUTSIDE WORKSPACE. EXISTING FIT-00 FLOW METER TO BE REMOVED. FOLLOWING COMPLETION OF NEW FLOW METER INSTALLATION, RUN NEW WIRING FROM EXISTING PLC CONTROL PANEL #1, MATCHING WITH REMOVED WIRING, TO FLOW TRANSMITTER AND ALSO EXTEND CONDUIT TO NEW FLOW TRANSMITTER, MATCHING WITH EXISTING CONDUIT. FURNISHED CABLES BETWEEN NEW FIT AND FE TO BE INSTALLED BY ELECTRICAL CONTRACTOR. FLOW METER TRANSMITTER AND ELEMENT SHALL BE RETAGGED AS FIT-2/FE-2
- PROVIDE 20A/1P CIRCUIT BREAKER IN AVAILABLE SPACE IN PANEL PP1 FOR LOAD.
- PROVIDE 20A/1P CIRCUIT BREAKER IN AVAILABLE SPACE IN PANEL PP2 FOR LOAD.

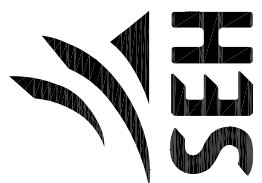
WELL 719 WATER TREATMENT
PLANT IMPROVEMENTS FOR WELL 8
ELK RIVER MUNICIPAL UTILITIES
ELK RIVER, MINNESOTA

SEH FILE NO. ELKMU 192017
PROJECT NO. 08/04/2026
ISSUE DATE B3W
DESIGNED BY NGL
MARK DATE DESCRIPTION
REVISIONS

SHEET TITLE
ELECTRICAL - PLC
ONE-LINE DIAGRAMS

SHEET
E6

3535 VADNAS CENTER DR
ST PAUL, MN 55110
(612) 480-2150
FAX: 651-480-2150
WATTS: 800-325-2055
www.sehinc.com



			PANELBOARD: (EXIST) PP1				BUS: COPPER			MAINS: 3P-100A MAIN BREAKER						
PHASE			SERVICE: 120/208V, 3PH, 4W, S/N				RATING: 100A			LOCATION: FILTER BLDG				PHASE		
"A"	"B"	"C"	MOUNTING: SURFACE							RM FILTER				"A"	"B"	"C"
V.A.	V.A.	V.A.	LOAD				P	BKR	CKT #	BKR	P	LOAD				V.A.
			FLUORIDE RM RCPT				1	20	1	2	15	1	*FLUORIDE RM VENTILATION			
			RECLAIM EXHAUST FAN				1	20	3	4	20	1	CHEMICAL PUMP			
			FILTER ROOM RCPTS				1	20	5	6	20	1	CHEMICAL PUMP			
			FLUORIDE BREAK PUMP				1	20	7	8	20	1	FILTER RM LTG			
			FLUORIDE WELL 7 PUMP				1	20	9	10	20	1	AUTOMATIC SYSTEMS CONTROL			
			SPACE				1	20	11	12	20	1	FILTER RM RCPTS			
			SPACE				1	20	13	14	20	1	CHLORINE RM LTG & FAN			
			CHLORINE ANALYZER				1	20	15	16	20	1	GENERATOR BATT, CHARGER, HTR			
			CHLORINE EM LTG, LEAK DETECT				1	20	17	18	20	1	AIR DRYER			
			WATER SALESMAN				1	20	19	20	20	1	SPACE			
			LIGHT ON WATER SALESMAN				1	20	21	22	20	1	SPACE			
			FLOW TRANSMITTER FT-2				1	20	23	24	20	1	FLOW TRANSMITTER T-1			
			*PHOSPHATE METER PUMP SPARE				1	20	25	26	20	1	SPACE			
			SPACE				1	20	27	28	20	1	SPACE			
			SPACE				1	20	29	30	20	1	SPACE			
0			TOTAL "A"										TOTAL "A"			
	0		TOTAL "B"										TOTAL "B"			
		0	TOTAL "C"										TOTAL "C"			
TOTAL =																

NOTES 1. MINIMUM 3/4"C, #12AWG.
2. 30AMP CIRCUITS = #10AWG
3. 40AMP CIRCUITS = #8AWG, #10G

*UPDATED:BOLD

			PANELBOARD: PP2				BUS: COPPER			MAINS: 3P-100A MAIN BREAKER						
PHASE			SERVICE: 120/208V, 3PH, 4W, S/N				RATING: 100A			LOCATION: FILTER ROOM				PHASE		
"A"	"B"	"C"	MOUNTING: SURFACE							RM 107				"A"	"B"	"C"
V.A.	V.A.	V.A.	LOAD				P	BKR	CKT #	BKR	P	LOAD				V.A.
1017			RM 107 INTERIOR LIGHTING				1	20	1	2	20	1	SPARE			
	41		RM 107 EXTERIOR LIGHTING				1	20	3	4	20	1	SPARE			
			PLC-2				1	20	5	6	20	1	EF-2,EF-3, MD-2, & MD-3			
900			RM 106, 107 RECEPTACLES				1	20	7	8	20	1	EF-4,EF-5, MD-4, & MD-5			
	1200		RM 107 PLC PANEL				1	20	9	10	20	1	BACKWASH FLOW TRANSMITTERS			
		840	FIRE ALARM PANEL				1	20	11	12	20	1	CHLORINE ANALYZER			
							1	20	13	14	20	1				
							1	20	15	16	20	1				
							1	20	17	18	20	1				
							1	20	19	20	20	1				
							1	20	21	22	20	1				
							1	20	23	24	20	1				
							1	20	25	26	20	3	EUH-10			
			SPARE				1	20	27	28	20	3				
			SPARE				1	20	29	30	20	3				
1917			TOTAL "A"										TOTAL "A"			
	1241		TOTAL "B"										TOTAL "B"			
		840	TOTAL "C"										TOTAL "C"			
TOTAL =																

NOTES 1. MINIMUM 3/4"C, #12AWG.
2. 30AMP CIRCUITS = #10AWG
3. 40AMP CIRCUITS = #8AWG, #10G

3535 VADNAS CENTER DR
ST PAUL, MN 55110
TEL: 651.460.2150
FAX: 651.460.2150
WATTS: 800.325.2055
www.sehinc.com



WELL 7/9 WATER TREATMENT
PLANT IMPROVEMENTS FOR WELL 8
ELK RIVER MUNICIPAL UTILITIES
ELK RIVER, MINNESOTA

MARK

DATE

DESCRIPTION
REVISIONS

SEH FILE NO. ELKMU 192017
PROJECT NO. 08/04/2026
ISSUE DATE B3W
DESIGNED BY NGL
DRAWN BY

Short Elliott Hendrickson, Inc. © (SEH)

SHEET TITLE
ELECTRICAL - SCHEDULES

SHEET
E8